ProSoft® TECHNOLOGY

Where Automation Connects.

ProLinx®

HART

ProLinx Gateway

HART Master

July 07, 2009

DRIVER MANUAL

Important Installation Instructions

Power, Input and Output (I/O) wiring must be in accordance with Class I, Division 2 wiring methods, Article 501-4 (b) of the National Electrical Code, NFPA 70 for installation in the U.S., or as specified in Section 18-1J2 of the Canadian Electrical Code for installations in Canada, and in accordance with the authority having jurisdiction. The following warnings must be heeded:

A WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIV. 2;
B WARNING - EXPLOSION HAZARD - WHEN IN HAZARDOUS LOCATIONS, TURN OFF POWER BEFORE REPLACING OR WIRING MODULES, and
C WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NONHAZARDOUS.
D "THIS DEVICE SHALL BE POWERED BY CLASS 2 OUTPUTS ONLY.

All ProLinx® Products

WARNING – EXPLOSION HAZARD – DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

AVERTISSEMENT – RISQUE D'EXPLOSION – AVANT DE DÉCONNECTER L'EQUIPMENT, COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX.

Markings

UL/cUL	ISA 12.12.01 Class I, Div 2 Groups A, B, C, D
cUL	C22.2 No. 213-M1987

243333 183151

CL I Div 2 GPs A, B, C, D

Temp Code T5

II 3 G

Ex nA nL IIC T5 X

0° C <= Ta <= 60° C

II – Equipment intended for above ground use (not for use in mines).

3 – Category 3 equipment, investigated for normal operation only.

G – Equipment protected against explosive gasses.

ProLinx Gateways with Ethernet Ports

Series C ProLinx™ Gateways with Ethernet ports do **NOT** include the HTML Web Server. The HTML Web Server must be ordered as an option. This option requires a factory-installed hardware addition. The HTML Web Server now supports:

- 8 MB file storage for HTML files and associated graphics files (previously limited to 384K)
- 32K maximum HTML page size (previously limited to 16K)

To upgrade a previously purchased Series C model:

Contact your ProSoft Technology distributor to order the upgrade and obtain a Returned Merchandise Authorization (RMA) to return the unit to ProSoft Technology.

To Order a ProLinx Plus gateway with the -WEB option:

Add **-WEB** to the standard ProLinx part number. For example, **5201-MNET-MCM-WEB**.

Your Feedback Please

We always want you to feel that you made the right decision to use our products. If you have suggestions, comments, compliments or complaints about the product, documentation or support, please write or call us.

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HART Driver Manual
July 07, 2009

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ProSoft Technology® Product Documentation

In an effort to conserve paper, ProSoft Technology no longer includes printed manuals with our product shipments. User Manuals, Datasheets, Sample Ladder Files, and Configuration Files are provided on the enclosed CD, and are available at no charge from our web site: www.prosoft-technology.com

Printed documentation is available for purchase. Contact ProSoft Technology for pricing and availability.

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1 Start Here

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1.1 System Requirements

The ProSoft Configuration Builder for the HART module requires the following minimum hardware and software components:

- Pentium® II 450 MHz minimum. Pentium III 733 MHz (or better) recommended
- Supported operating systems:
  - Microsoft Windows XP Professional with Service Pack 1 or 2
  - Microsoft Windows 2000 Professional with Service Pack 1, 2, or 3
  - Microsoft Windows Server 2003
- 128 Megabytes of RAM minimum, 256 Megabytes of RAM recommended
- 100 Megabytes of free hard disk space (or more based on application requirements)
- 256-color VGA graphics adapter, 800 x 600 minimum resolution (True Color 1024 × 768 recommended)
- CD-ROM drive

1.2 Package Contents

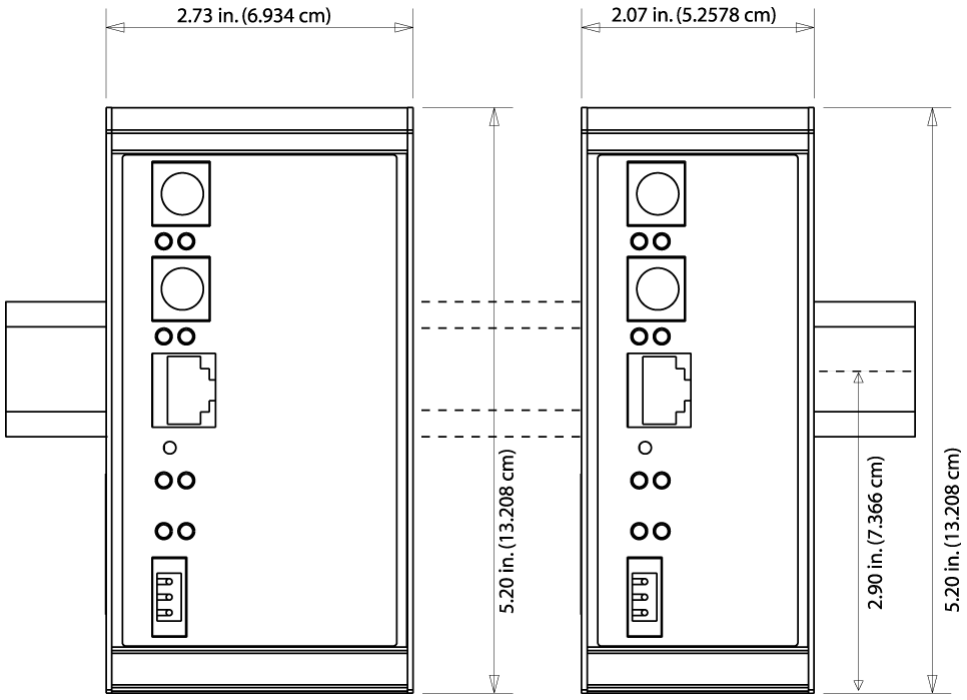
The following components are included with your HART module, and are all required for installation and configuration.

Important: Before beginning the installation, please verify that all of the following items are present.

Qty.	Part Name	Part Number	Part Description
1	HART Module	PLX-####	ProLinx communication gateway module
1	Cable	Cable #15, RS232 Null Modem	For RS232 Connection to the CFG Port
Varies	Cable	Cable #9, Mini-DIN8 to DB9 Male Adapter	For DB9 Connection to Module's Port. One DIN to DB-9M cable included per configurable serial port
Varies	Adapter	1454-9F	Adapters, DB9 Female to Screw Terminal. For RS422 or RS485 Connections to each serial application port of the Module
1	ProSoft Solutions CD		Contains sample programs, utilities and documentation for the HART module.

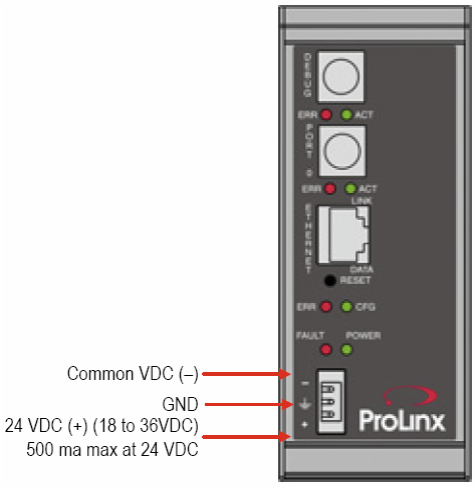
If any of these components are missing, please contact ProSoft Technology Support for replacement parts.

1.3 Mounting the Module on the DIN-rail



ProLinx 5000/6000 Series Module

1.4 Connecting Power to the Unit



WARNING: Ensure that you do not reverse polarity when applying power to the module. This will cause damage to the module's power supply.

1.5 Install ProSoft Configuration Builder Software

You must install the ProSoft Configuration Builder (PCB) software in order to configure the module. You can always get the newest version of ProSoft Configuration Builder from the ProSoft Technology web site.

To install ProSoft Configuration Builder from the ProSoft Web Site

1. Open your web browser and navigate to *http://www.prosoft-technology.com/pcb*
2. Click the **DOWNLOAD HERE** link to download the latest version of ProSoft Configuration Builder.
3. Choose **"SAVE"** or **"SAVE FILE"** when prompted.
4. Save the file to your Desktop, so that you can find it easily when you have finished downloading.
5. When the download is complete, locate and open the file, and then follow the instructions on your screen to install the program.

If you do not have access to the Internet, you can install ProSoft Configuration Builder from the ProSoft Solutions CD-ROM, included in the package with your module.

To install ProSoft Configuration Builder from the Product CD

1. Insert the ProSoft Solutions Product CD into the CD drive of your PC. Wait for the startup screen to appear.
2. On the startup screen, click **PRODUCT DOCUMENTATION**. This action opens an explorer window.

3 Click to open the **UTILITIES** folder. This folder contains all of the applications and files you will need to set up and configure your module.
4 Double-click the **SETUPCONFIGURATIONTOOL** folder, double-click the **"PCB_*.EXE"** file and follow the instructions on your screen to install the software on your PC. The information represented by the "*****" character in the file name is the PCB version number and, therefore, subject to change as new versions of PCB are released.

Note: Many of the configuration and maintenance procedures use files and other utilities on the CD-ROM. You may wish to copy the files from the Utilities folder on the CD-ROM to a convenient location on your hard drive.

1.5.1 Using the Help System

Most of the information needed to help you use ProSoft Configuration Builder is provided in a Help System that is always available whenever you are running ProSoft Configuration Builder. The Help System does not require an Internet connection.

To view the help pages, start ProSoft Configuration Builder, open the **HELP** menu, and then choose **CONTENTS.**

2 Functional Overview

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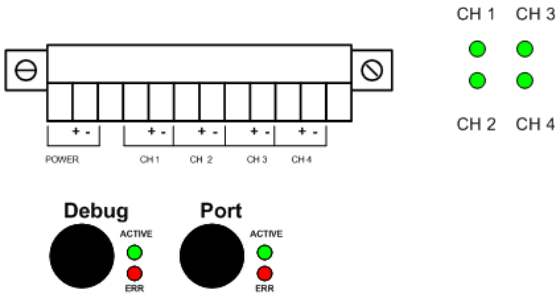
- HART Channel Specifications 13
- Module Internal Database 15

The HART Master Protocol exists in 4 and 8 channel implementations. This driver can be configured on an individual channel basis to operate as a HART Master Station and supports all the available HART commands including Universal, Common Practice and Device Specific Commands. Each HART channel is independently configured to interface with the internal database in the module.

HART® is a registered trademark of the HART Communication Foundation

2.1 HART Channels

The ProLinx module supports the HART protocol as a Master on up to 8 channels per interface card. Each channel is individually configurable.



The relationship between the port labeling on the front of the ProLinx module and the application is as follows:

Port Label	Function
Debug	Debug/configuration
Port 0	Communications Port 0
Channel 1	Hart Port 0
Channel 2	Hart Port 1
Channel 3	Hart Port 2
Channel 4	Hart Port 3
Channel 5	Hart Port 4

Port Label	Function
Channel 6	Hart Port 5
Channel 7	Hart Port 6
Channel 8	HART Port 7

The HART protocol uses the Bell 202 standard frequency shift keying (FSK) signal to communicate at 1200 baud, superimposed at a low level on the 4 to 20 mA analog measurement signal. Having an average value of zero, an FSK signal causes no interference with the analog value. The HART devices are powered from this 4 to 20 mA analog loop.

All HART protocol channels in the ProLinx module generate the Bell 202 FSK signal to communicate in multi-drop mode with up to 15 HART devices and provide up to 300 mA supply for the analog loop in multi-drop mode. Refer to the Reference chapter for ProLinx HART field connection information.

User configured commands determine the HART commands to be issued on each channel to the HART devices. Up to 100 commands can be defined for each port. Data read from the devices are placed in the virtual database. Any write requests or device specific command for the HART slave devices are sourced with data from the virtual database or from a configured constant data block. In the commands it can be specified whether to use the HART device's short or long address. If the long address is selected, the device is polled first with short address to ask for the long one. Then the device is polled with the long address. The module does all this processing of the address automatically.

The module can be configured to place slave devices that are not responding to commands from the master ports at a lower priority. If the module recognizes that a slave device has failed to respond to a message after the user defined retry count, it will mark the slave as "in communication failure" and set the error delay time to the specified value. Each time that the error delay time expires, the slave will be polled and if the answer is successful, the slave is placed again in an active status. This facility can improve communication throughput on the HART network.

In a HART network, it is possible to have two masters. The ProLinx module fully supports the existence of a second master, but it can reduce the throughput on the HART network. This facility is enabled or disabled in the module's configuration. If the ability to have a second master on the network is disabled, then the maximum throughput is achieved.

2.2 HART Channel Specifications

<table>
<tr><th>Type</th><th>Specifications</th></tr>
<tr><td colspan="2">General Parameters (Software Configurable)</td></tr>
<tr><td>Internal Database</td><td>4000 registers (words) available</td></tr>
<tr><td>Communication parameters</td><td>Number of HART Preambles: 2 to 50
Enable Handheld: Y or N
Primary Master: Y or N</td></tr>
<tr><td>Configurable Parameters per Channel</td><td>Short Address Retries
Long Address Retries
Retries After Error
Poll Time After Error
Number of Commands
Slave List Error Pointer</td></tr>
<tr><td>HART Commands supported</td><td>Universal Command Set
<table>
<tr><td>00</td><td>Read Unique Identifier</td></tr>
<tr><td>01</td><td>Read Primary Variable</td></tr>
<tr><td>02</td><td>Read Current And Percent Of Range</td></tr>
<tr><td>03</td><td>Read Dynamic Variables</td></tr>
<tr><td>06</td><td>Write Polling Address</td></tr>
<tr><td>11</td><td>Read Unique Identifier Associated With Tag</td></tr>
<tr><td>12</td><td>Read Message</td></tr>
<tr><td>13</td><td>Read Tag Descriptor Date</td></tr>
<tr><td>14</td><td>Read PV Sensor Info</td></tr>
<tr><td>15</td><td>Read Output Information</td></tr>
<tr><td>16</td><td>Read Final Assembly Number</td></tr>
<tr><td>17</td><td>Write Message</td></tr>
<tr><td>18</td><td>Write Tag Descriptor Date</td></tr>
<tr><td>19</td><td>Write Final Assembly Number</td></tr>
</table>
Common Practice Command Set
<table>
<tr><td>33</td><td>Read Transmitter Variables</td></tr>
<tr><td>34</td><td>Write Damping Value</td></tr>
<tr><td>35</td><td>Write Range Values</td></tr>
<tr><td>36</td><td>Set Upper Range Value</td></tr>
<tr><td>37</td><td>Set Lower Range Value</td></tr>
<tr><td>38</td><td>Reset Configuration Changed Flag</td></tr>
<tr><td>39</td><td>EEprom Control</td></tr>
<tr><td>40</td><td>Enter Exit Fixed Current Mode</td></tr>
<tr><td>41</td><td>Perform Transmitter Self Test</td></tr>
<tr><td>42</td><td>Perform Master Reset</td></tr>
<tr><td>43</td><td>Set Pv Zero</td></tr>
<tr><td>44</td><td>Write Pv Units</td></tr>
</table></td></tr>
</table>

Type	Specifications	
	45	Trim Dac Zero
	46	Trim Dac Gain
	47	Write Transfer Function
	48	Read Additional Transmitter Status
	49	Write Pv Sensor Serial Number
	50	Read Dynamic Variable Assignments
	51	Write Dynamic Variable Assignments
	52	Set Transmitter Variable Zero
	53	Write Transmitter Variable Units
	54	Read Transmitter Variable Information
	55	Write Transmitter Variable Damping Value
	56	Write Transmitter Variable Sensor Serial Number
	57	Read Unit Tag Descriptor Date
	58	Write Unit Tag Descriptor Date
	59	Write Number Of Response Preambles
	108	Write Burst Mode Command Number
	109	Burst Mode Control
	110	Read All Dynamic Variables
Command List	Up to 100 command per channel, each fully configurable for function, slave address, register to/from addressing and word count for Floating Point or Integer Data	
Status Data	Error codes returned by the HART protocol available on an individual command basis. In addition, a slave status list is maintained per active channel.	
Polling of command list	User configurable polling of commands, including disabled, continuous, on change of data (write only) and dynamically user or automatic enabled.	

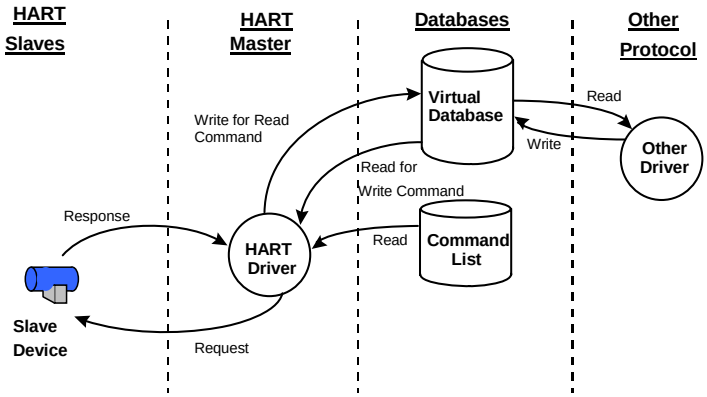
The ProLinx HART module supports version 5 of the HART protocol.

2.3 Module Internal Database

Central to the functionality of the module is the internal database. This database is shared between all the ports on the module and is used as a conduit to pass information from one device on one network to one or more devices on another network. This permits data from devices on one communication port to be viewed and controlled by devices on another port. In addition to data from the slave and master ports, status and error information generated by the module can also be mapped into the internal database.

2.3.1 HART Channel Driver Access to Database

The following illustration describes the flow of data between the HART channel drivers and the internal database.



The HART Master driver uses the database in two ways:

- A read command issued to a slave device by the master driver will return the slave data into the internal database
- A write command issued to a slave device by the master driver use the data in the internal database to write to the slave device

In addition to data from the master HART channels, detailed status and error information generated by the module can also be mapped into the internal database.

2.3.2 Auto-Polling

This feature is enabled by setting the AUTO-POLL CODE (in the configuration file) to a value of P (point-to-point) or M (multi-drop). If the value N is entered for the parameter, the auto-poll feature is disabled. When the feature is disabled, the channel will only execute the commands enabled in the user command list. When the auto-polling mode is enabled, the module will automatically acquire data from the HART instruments attached to a channel without the use of user commands. If user commands are present and enabled when the feature is enabled, they will also be executed independent of auto-polling.

With the auto-poll feature enabled, the module automatically generates the following HART commands and stores the data in the module's database at the user-specified location:

CMD	Description
0	Read Unique Identifier
3	Read Current and Four Dynamic Variables
13	Read Tag, Descriptor and Date
14	Read PV Sensor Information
15	Read Output Information

If the unit is set for point-to-point mode, the module will automatically gather the information for the device with the polling address (short address) of zero and place the data into the database. Each device requires a 50-word database area with the format shown in the following table.

DB Byte Offset	Type	Description	Byte Cnt	Data Source	Use of Data
0	byte	Auto-polling command status bits	1	App	Status
1	byte	Last first status byte received from device	1	Resp	Status
2	byte	Last second status byte received from device	1	Resp	Status
3	byte	Manufacture ID Code	1	CMD 0	LongAddress
4	byte	Device Type Code	1	CMD 0	LongAddress
5	byte	Minimum number of preambles	1	CMD 0	Msgconstruction
6	byte	Universal Command Major Rev #	1	CMD 0	Msgchoice
7	byte	Device Revision Level	1	CMD 0	Info
8	byte	Software Revision Level	1	CMD 0	Info
9	byte	Hardware Revision Level/Physical Signaling Code	1	CMD 0	Info
10	byte	Device Flags	1	CMD 0	Info
11 to 13	byte	Device ID	3	CMD 0	Long Address
14	byte	Minimum number of preambles to be sent with the response message from the slave to the master.	1	CMD 0	
15	byte	Maximum number of device variables	1	CMD 0	Info
16 to 17	word	Configuration Change Counter	2	CMD 0	Info
18	byte	Extended Field Device Status	1	CMD 0	Info
19	byte	Primary variable units code	1	CMD 3	Cfg
20	byte	Secondary variable units code	1	CMD 3	Cfg
21	byte	Tertiary variable units code	1	CMD 3	Cfg
22	byte	Quaternary variable units code	1	CMD 3	Cfg
23 to 30	byte	Tag name	8	CMD 13	Info
31 to 46	byte	Descriptor	16	CMD 13	Info

DB Byte Offset	Type	Description	Byte Cnt	Data Source	Use of Data
47 to 49	byte	Tag/Descriptor data	3	CMD 13	Info
50 to 52	byte	Transducer serial number	3	CMD 14	Info
53	byte	Transducer limits and min span units code	1	CMD 14	Info
54	byte	PV alarm selection code	1	CMD 15	Info
55	byte	PV transfer function code	1	CMD 15	Info
56	byte	PV upper and lower range value units code	1	CMD 15	Info
57	byte	Write protection code	1	CMD 15	Status
58	byte	Private label distributor code	1	CMD 15	Info
59	byte	PV analogchannel flag	1	CMD 15	Info
		TOTAL BYTE COUNT	60		
		TOTAL WORD COUNT	30		

DB Byte Offset	Type	Description	Byte Cnt	Data Source	Use of Data
60 to 63	float	Primary variable value	4	CMD 3	Status
64 to 67	float	Secondary variable value	4	CMD 3	Status
68 to 71	float	Tertiary variable value	4	CMD 3	Status
72 to 75	float	Quaternary variable value	4	CMD 3	Status
76 to 79	float	Upper transducer limit	4	CMD 14	Cfg
80 to 83	float	Lower transducer limit	4	CMD 14	Cfg
84 to 87	float	Minimum span	4	CMD 14	Cfg
88 to 91	float	PV upper range value	4	CMD 15	Cfg
92 to 95	float	PV lower range value	4	CMD 15	Cfg
96 to 99	float	PV damping value (in seconds)	4	CMD 15	Cfg
		TOTAL FLOAT BYTE COUNT	40		
		TOTAL FLOAT WORD COUNT	20		

DB Regs/Device	50
Max DB Regs/channel for 15 Devices	750
Max DB Regs for HART Card	3000

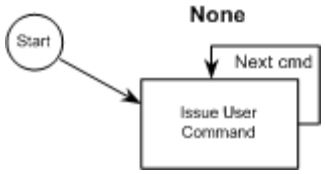
The following table defines the auto-polling command status bits:

Bit #	Description
0	Long Address Set (command 0 successful)
1	Command 13 successful (configuration)
2	Command 14 successful (configuration)
3	Command 15 successful (configuration)
4	Command 3 successful (data polling)
5	Reserved
6	Reserved
7	Reserved

The following topics describe the modes of module operation.

Auto-Poll Disabled Mode

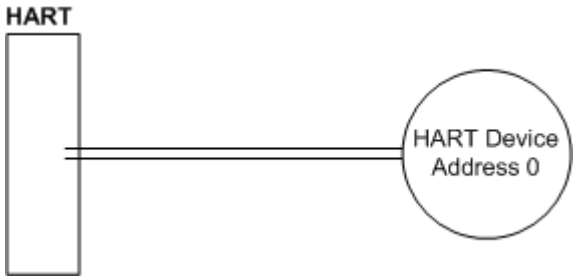
If the auto-polling feature is disabled (Auto-Poll Code = N), the module functions as shown in the following diagram:



Only the user commands are executed and all data is placed in and sourced from the module's internal database. The user is responsible for constructing all commands to control and monitor the instruments attached to the channel.

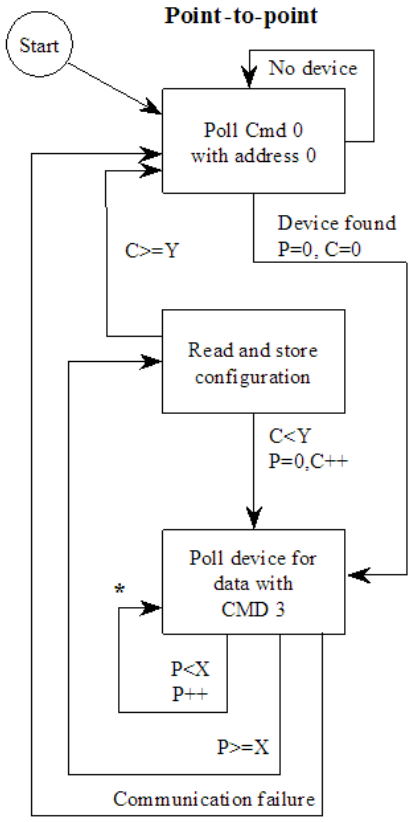
Point-to-Point Mode

Important: If the HART device address is 0 you must configure the channel for Point-to-Point mode.



In point-to-point mode, the module only polls for a single instrument with a polling address of zero. When the instrument is found by the channel, it continuously polls for the data using command 3. Occasionally, it will poll for the configuration information for the device. This is accomplished with HART commands 13, 14 and 15. Less frequently, the channel will perform a HART command 0 request to see if any of the data for the instrument has changed. If communications is lost with the device, the module will try to establish communications with the device using command 0. If user commands are present and enabled, they will be executed after each data poll.

When the point-to-point mode of auto-polling is enabled (Auto-Poll Code = P), the following diagram applies to the channel operation:

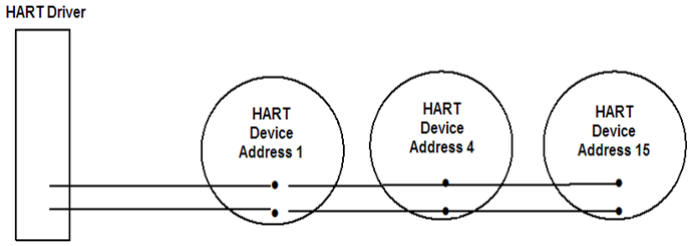


Where
P, C = loop iterators
X = Poll Counter (internal fixed value

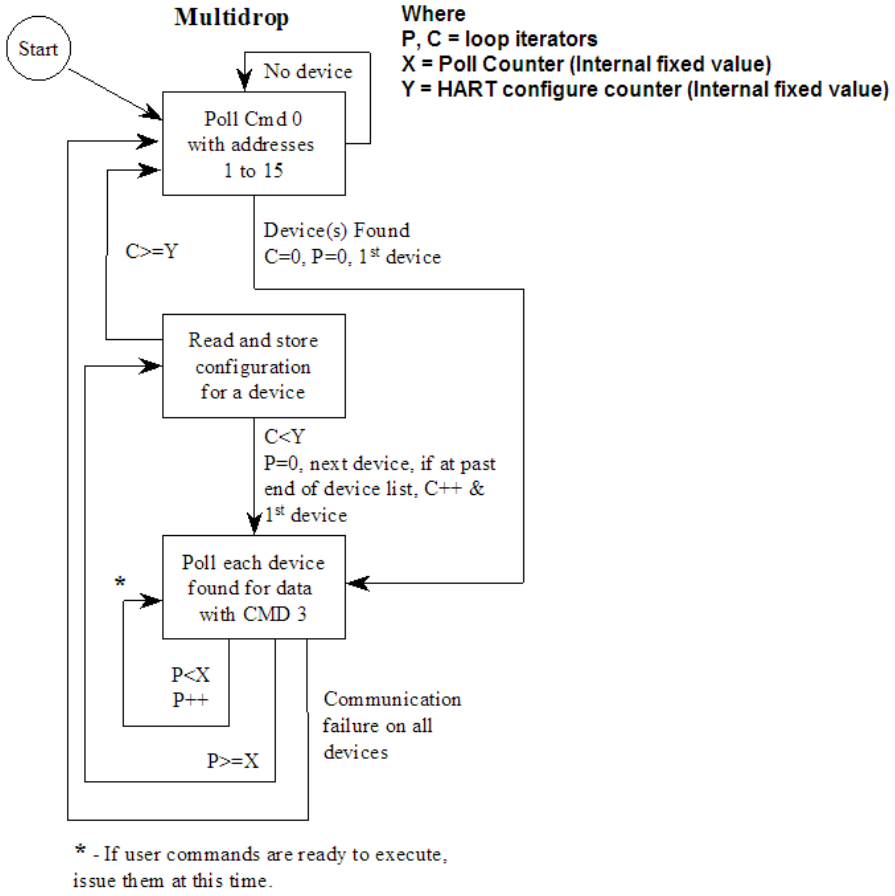
Multi-drop Mode

Important: If the HART device address is between 1 and 15, you must configure the channel for multi-drop mode.

If the unit is set for multi-drop mode, the module will poll each unit attached to the channel starting with polling address 1. The parameter MAX DEVICE COUNT in the configuration determines the maximum slave address number to be polled in multi-drop mode. For example, if the MAX DEVICE COUNT parameter is set to 3, the channel will poll for polling addresses 1, 2, and 3. It is important when assigning the device polling addresses for instruments on a channel to start with 1 and successfully increase the value by one until the last instrument is assigned an address. If you set the MAX DEVICE COUNT parameter to 2, and assign the two instruments addresses 1 and 15, the polling address 15 will never be used (only addresses 1 and 2). Therefore, the second instrument will never be polled and will be in communication failure. Up to 15 instruments can be assigned to a single channel (polling address 1 to 15).



If the module is configured for multi-drop auto-polling (Auto-Poll Code = M), the following diagram applies:


Multidrop
Where
P, C = loop iterators
X = Poll Counter (Internal fixed value)
Y = HART configure counter (Internal fixed value)
Start
No device
Poll Cmd 0 with addresses 1 to 15
Device(s) Found C=0, P=0, 1st device
C>=Y
Read and store configuration for a device
C<Y P=0, next device, if at past end of device list, C++ & 1st device
Poll each device found for data with CMD 3
*
P<X P++
P>=X
Communication failure on all devices
* - If user commands are ready to execute, issue them at this time.

In multi-drop mode, the channel will poll for instruments 1 to the value set in the MAX DEVICE COUNT parameter. For each device found, it will continuously poll for data using command 3. After a certain number of iterations, the HART Driver will ready the configuration data for the next device (if there is one). Each time configuration information is acquired, it will be for a different slave device if more than 1 slave is recognized by the channel. Less frequently, the channel will poll for devices not found in the original search of the network using HART command 0. If communications is lost with all devices, the module will try to establish communications with the devices using command 0. If user commands are present and enabled, they will be executed after the data polling of the devices.

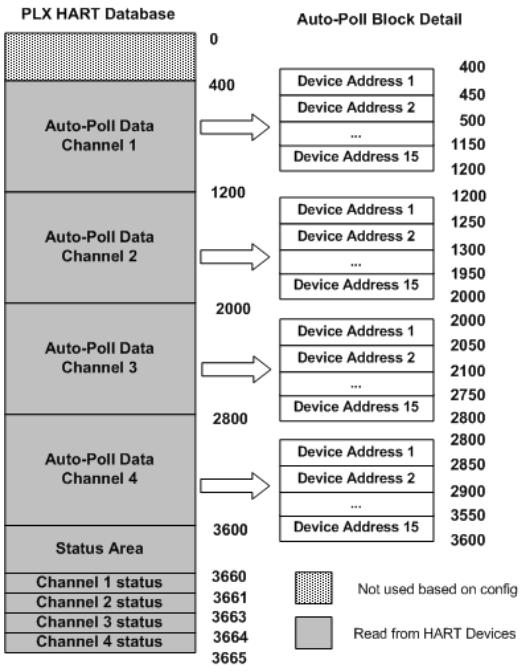
Multi-drop Mode Example:

The intent is to show when using Multi-drop mode how the Auto-Poll DB Address and Max Device Count parameters should be used.

If the configuration file sets the following parameters:

Parameter	Value	Config File Section
DB Address Status	3660	[HART PORT 0]
Auto-Poll DB Address	400	
Max Device Count	15	
DB Address Status	3661	[HART PORT 1]
Auto-Poll DB Address	1200	
Max Device Count	15	
DB Address Status	3662	[HART PORT 2]
Auto-Poll DB Address	2000	
Max Device Count	15	
DB Address Status	3663	[HART PORT 3]
Auto-Poll DB Address	2800	
Max Device Count	15	

The HART database has the following structure.



The configuration file for this example shows that when the MAX Device Address parameter is configured as 15, the module will reserve 800 words for each channel (15 devices x 50 words each) even though not all devices may be present on the network.

2.3.3 HART Command List

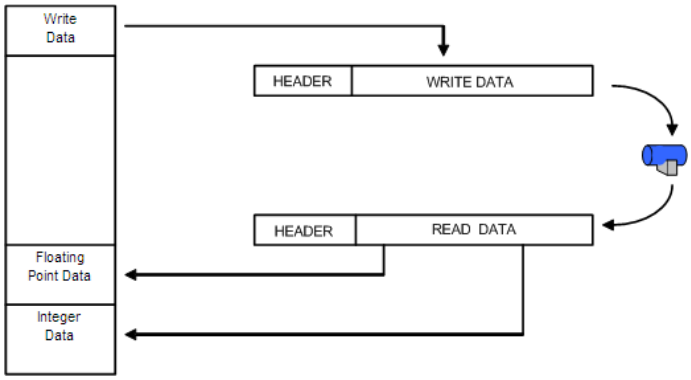
The HART Command List specifies the commands to be executed to the HART devices connected to a channel. A HART command can be seen as an outgoing message to the HART devices that provides Write Data for a specific command or a response message that carries process data (Read Data) back to the module. The ProLinx module supports three kinds of data blocks in the Universal and Common Practice commands. These data blocks are:

- Integers
- IEEE 754 Floating Point Numbers (32 bits)
- Packed ASCII character strings

The Packed ASCII character strings are unpacked and placed with the integers data block.

For all commands, it is possible to select where the Write Data comes from; it can be in the module's internal database or it can be configured as a fixed data block in the command.

For response messages from HART devices, it is possible to configure where the Floating Point Data and Integer Data will be placed in the module's internal database, but this is only possible for the Universal and Common Practice commands. In the case of Device Specific commands, all the Read Data is placed in the Integer data section. See HART Command Support for a listing of supported HART commands.



3 Configure the Gateway

In This Chapter

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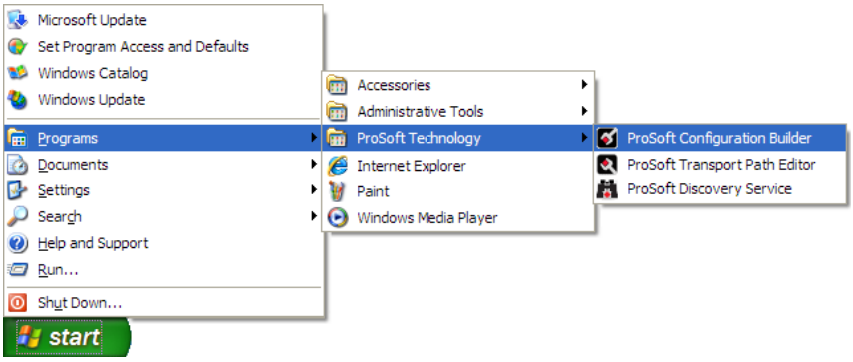
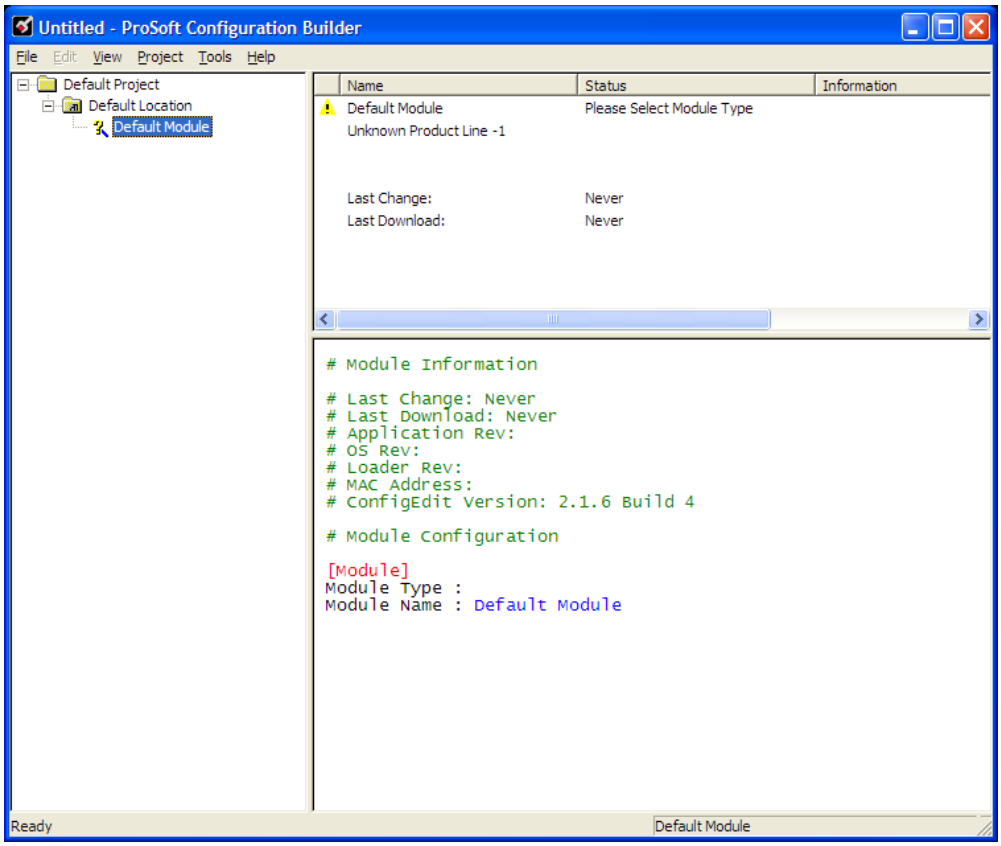
- Printing a Configuration File 28
- [HART PORT x] 28
- [HART PORT x COMMANDS] 31
- Data Map 39
- HART Command Entry Formats 41
- Downloading a File from PC to the Gateway 42

To begin, start **PROSOFT CONFIGURATION BUILDER** (PCB).

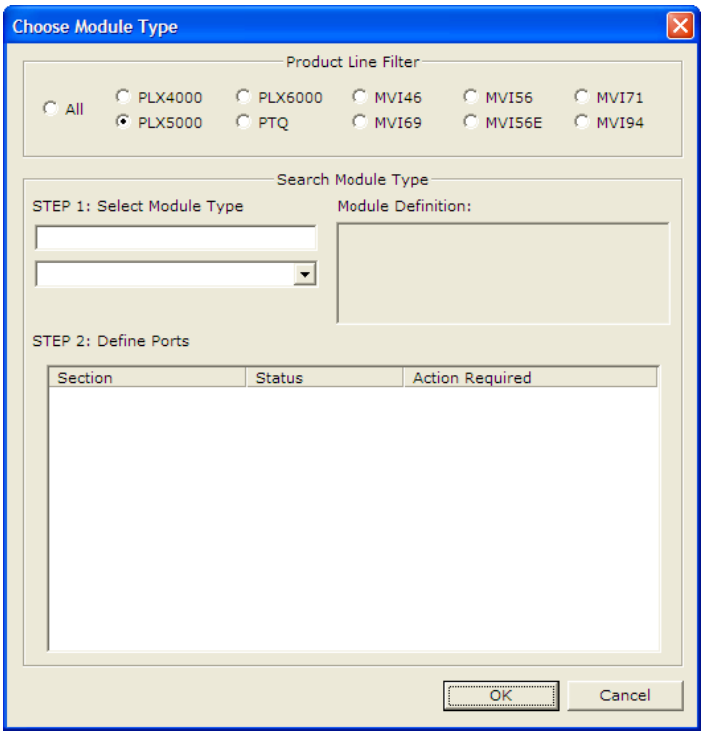


If you have used other Windows configuration tools before, you will find the screen layout familiar. PCB's window consists of a tree view on the left, and an information pane and a configuration pane on the right side of the window. When you first start *PCB*, the tree view consists of folders for **DEFAULT PROJECT** and **DEFAULT LOCATION**, with a **DEFAULT MODULE** in the Default Location folder. The following illustration shows the *PCB* window with a new project.



Your first task is to add the HART module to the project.

1 Use the mouse to select **DEFAULT MODULE** in the tree view, and then click the right mouse button to open a shortcut menu.
2 On the shortcut menu, choose **CHOOSE MODULE TYPE**. This action opens the **CHOOSE MODULE TYPE** dialog box.



3 In the **PRODUCT LINE FILTER** area of the dialog box, select the ProLinx Series (4000, 5000, or 6000) for your gateway.
4 In the **SELECT MODULE TYPE** dropdown list, select your gateway, and then click **OK** to save your settings and return to the ProSoft Configuration Builder window.

3.1 Module Entries

To configure module parameters

1 Click on the plus sign next to the icon to expand module information.
2 Double-click the icon to open the **EDIT** dialog box.
3 To edit a parameter, select the parameter in the left pane and make your changes in the right pane.
4 Click **OK** to save your changes.

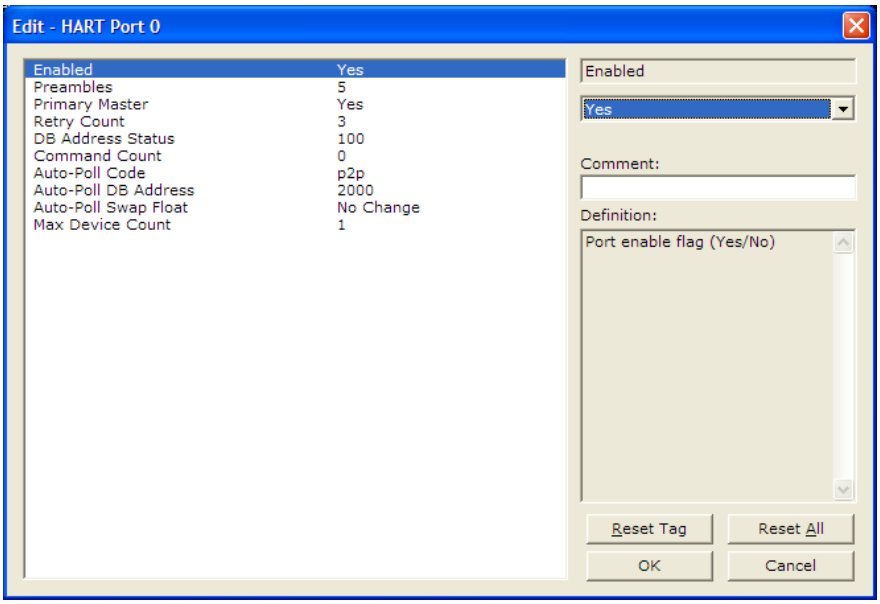
3.2 Printing a Configuration File

To print a configuration file:

1. Select the **MODULE** icon, and then click the right mouse button to open a shortcut menu.
2. On the shortcut menu, choose **VIEW CONFIGURATION.** This action opens the **VIEW CONFIGURATION** window.
3. On the **VIEW CONFIGURATION** window, open the **FILE** menu, and choose **PRINT.** This action opens the **PRINT** dialog box.
4. On the **PRINT** dialog box, choose the printer to use from the dropdown list, select printing options, and then click **OK.**

3.3 [HART PORT x]

The [HART PORT 0], [HART PORT 1], [HART PORT 2], [HART PORT 3] [HART PORT 4], [HART PORT 5], [HART PORT 6] and [HART PORT 7] sections of the configuration set the HART channel communication parameters, define the protocol specifics and set the command list parameters. The parameters are the same for all 8 sections. The command list for each HART channel is entered in a different section in the file.



3.3.1 Enabled

Y or N

This parameter enables or disables the specific HART channel. If the parameter is set to "Y", the channel will be utilized. If set to "N", the channel will not be used.

3.3.2 Preambles

2 to 50

This parameter defines the number of 0xFF characters (preambles) that will be placed at the start of each HART frames.

3.3.3 Primary Master

Yes or No

This parameter specifies the Link Quiet / Slave Timeout. If set to Yes, the selected Link Quiet / Slave Timeout is 305 milliseconds which corresponds to the Primary Master. If set to No, then this time is 380 milliseconds which corresponds to the Secondary Master.

3.3.4 Retry Count

0 to 10

This parameter sets the number of retries for a command if the command response is not received from the slave device. This parameter is normally set to a value of 3. The module will accept values of 0 to 10.

3.3.5 DB Address Status

-1, 0 to 3999

This parameter is utilized to set the database address in the module where the status word for the channel will be placed. If the parameter is set to -1, the word value will not be placed in the database. If a value from 0 to 3999 is set for the parameter, the status word for the channel will be placed at the specified database offset. This word is bit mapped with each bit representing a slave device. The bit will be set if slave device has a communication error.

3.3.6 Command Count

0 to 99

This parameter sets the number of user commands to be utilized. The first command in the list is always reserved for the auto-poll command so the user should configure this value considering one command for the auto-poll. For example, if the user configures two commands, the command count parameter should be set as 3. This parameter can be set from 0 to 99. If the parameter is set to a value other than 0, commands should be present in the [HART PORT x COMMANDS] section.

3.3.7 Auto-Poll Code

P, M or N

This parameter sets the auto-poll mode of the channel. If the parameter is set to P, the module will automatically poll device 0 in point-to-point mode. If the parameter is set to M, the module will automatically poll devices 1 to n (n=value of parameter Max Device Count). If the parameter is set to N, the auto-polling option will be disabled and only commands in the command list will be utilized for the channel. In the auto-poll mode, the module will automatically execute HART commands 0, 3, 13, 14 and 15.

3.3.8 Auto-Poll DB Address

0 to 3700

This parameter sets the starting address for the data obtained by the auto-poll feature. Each device on a channel requires 50 words in the database. The data area selected must not overlap any portion of the database used by other channels or the module.

3.3.9 Auto-Poll Swap Float

0 to 3

This parameter swaps the floating-point data values received by the auto-poll feature.

Swap Code	Description
0	None - No Change is made in the byte ordering (1234 = 1234)
1	Words - The words are swapped (1234=3412)
2	Words & Bytes - The words are swapped then the bytes in each word are swapped (1234=4321)
3	Bytes - The bytes in each word are swapped (1234=2143)

Depending on the host processor using the data, the proper swap code must be utilized to present the data in the correct format.

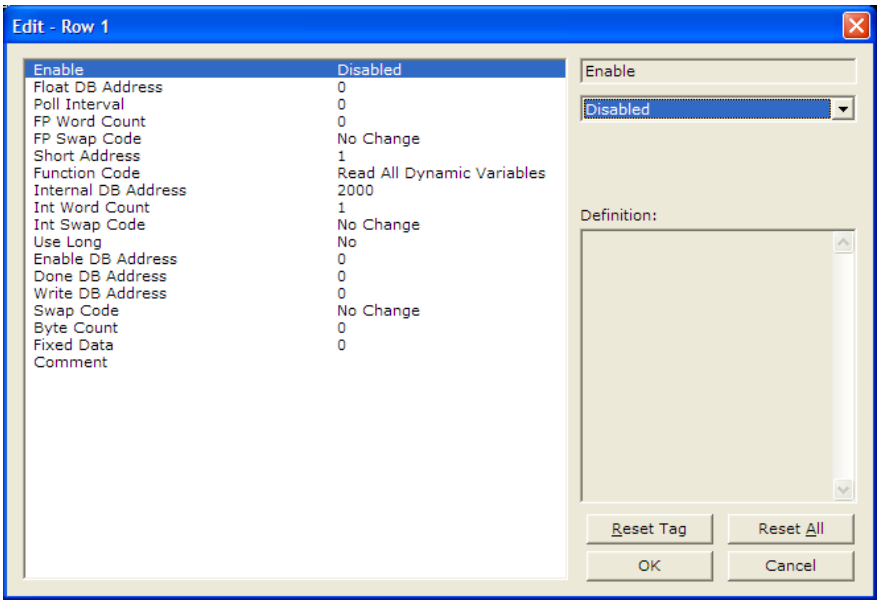
3.3.10 Max Device Count

1 to 15

This parameter sets the maximum number of slave devices to be utilized for the auto-poll feature. In point-to-point mode, the parameter should be set to a value of 1. In multi-drop mode, the parameter should be set from 1 to 15 to represent the number of slave devices attached to the channel.

3.4 [HART PORT x COMMANDS]

The [HART PORT *x* COMMANDS] sections of the CFG file set the user defined HART channel command lists. These lists poll slave devices attached to the HART channels. The module supports numerous commands.



3.4.1 Command List Overview

The HART module uses a command list to interface with HART slave devices. The commands in the list specify

- the slave device to be addressed
- the function to be performed (read or write)
- the registers in the internal database to be associated with the device data.

There is a separate command list for each HART channel, with up to 99 commands allowed per channel. The command list is processed from top (command #0) to bottom.

A poll interval parameter is associated with each command to specify a minimum delay time in seconds between the issuance of a command. For example, a poll interval of 10 executes the command no more frequently than every 10 seconds.

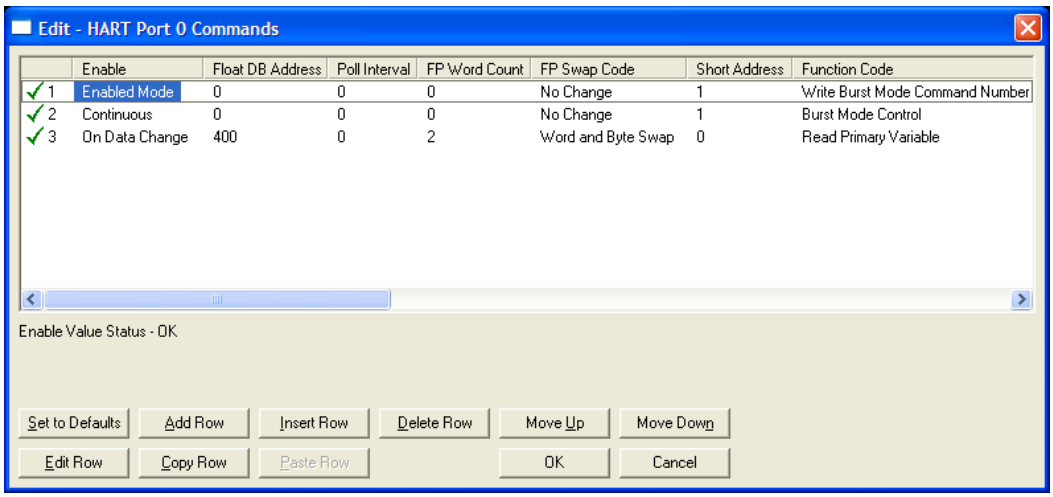
Write commands have a special feature, as they can be set to execute only if the data in the write command changes. If the register data values in the command have not changed since the command was last issued, the command will not be executed. If the data in the command has changed since the command was last issued, the command will be executed. Use of this feature can lighten the load on the HART network. In order to implement this feature, set the enable code for the command to a value of 2.

The module supports all the Universal (page 51) and Common Practice (page 64) commands, as well as device specific commands. A Device Specific command is supported without any translation of the data.

3.4.2 HART Command Entry Formats

Refer to HART Command Support (page 34) for a complete discussion of the HART commands supported by the module, and the structure and content of the data returned for each command.

The following illustration shows a command list section of the CFG file:



3.4.3 Enable

0, 1, 2, 3, 4, 5

This field defines whether the command is to be executed and under what conditions.

Code	Description
0	The command is disabled and will not be executed in the normal polling sequence. This can be used to process a command from a bursting slave device.
1	Causes the command to be executed each scan of the command list if the Poll Interval Time is set to zero. If the Poll Interval time is set, the command will be executed, when the interval timer expires.
2	The command will execute only if the internal data associated with the command changes. This value is valid only when there is a specified "Write DB Address" (see below) with a non zero byte count for write commands.
3	The HART module will send the command if either the HART module OR the HART device is powered up. This is mainly used for configuration of HART devices on startup.

Code	Description
4	Places the command in enabled mode. This option is valid only if there is a specified "Enabled DB Address" (see below). If the Virtual Database word specified in "Enabled DB Address" has "-1" the command will be executed otherwise it will not.
5	Places the command in one shot enabled mode. This option is valid only if there is a specified "Enabled DB Address" (see below). If the Virtual Database word specified in "Enabled DB Address" has a value of "-1" the command will be executed otherwise it will not. When the command has been successful the Virtual Database word specified in "Enabled DB Address" will be written with "0", so the command will be executed only once.

3.4.4 Float DB Address

0 to 3998

This field specifies the internal database register where the floating point values returned by the command will be placed.

3.4.5 Poll Interval

0 to 65535

This parameter specifies the minimum interval to execute continuous commands (Enable code of 1). The parameter is entered in units of seconds. Therefore, if a value of 10 is entered for a command, the command will execute no more frequently than every 10 seconds.

3.4.6 FP Word Count

-1 to 125

This parameter specifies the number of words from the floating point data returned by a HART command that will be placed on the Virtual Database. If this parameter is 0 no data will be written to the Database. If this parameter is -1 then all the floating point data will be written in the integer block of data.

Special care should be taken with this number, because is a word count and a floating point value is 2 words long. For example if you execute a HART command 3 which takes 5 floating point values from the device, you should place a word count of 10 words.

3.4.7 Swap Code

0, 1, 2, 3

This parameter defines the byte order of each four-byte group of data received. This parameter is helpful when dealing with floating-point or other multi-register values, as there is no standard byte order for storing these data types. The following table describes the values and their associated operations:

Swap Code	Description
0	None - No Change is made in the byte ordering (1234 = 1234)
1	Words - The words are swapped (1234=3412)
2	Words & Bytes - The words are swapped then the bytes in each word are swapped (1234=4321)
3	Bytes - The bytes in each word are swapped (1234=2143)

3.4.8 Short Address

1 to 15

This parameter specifies the HART slave node address on the network to be considered. Values of 1 to 15 are permitted. If the device to be addressed only accepts long address, then the parameter "Use Long" should be selected so the module can ask for the long address with the short one and then execute the command.

3.4.9 Function Code

0 to 255

This parameter specifies the HART function to be executed. Any HART function can be executed, even device specific ones, but only supported commands will return formatted data and classified in floating point data and integer data.

Commands Supported by the Module

The format of each command in the list is independent on the function being executed. All parameters in the command table must be entered. Only one parameter is optional, the Fixed Data field, which contains data to be sent to a HART device. The tables below list the functions supported by the module:

HART Universal Commands Set

Command	Definition
00	Read Unique Identifier
01	Read Primary Variable
02	Read Current And Percent Of Range
03	Read Dynamic Variables
06	Write Polling Address
07	Read Loop Configuration
08	Read Dynamic Variable Classifications
09	Read Device Variables with Status
11	Read Unique Identifier Associated With Tag
12	Read Message
13	Read Tag Descriptor Date
14	Read PV Sensor Info
15	Read Output Information

Command	Definition
16	Read Final Assembly Number
17	Write Message
18	Write Tag Descriptor Date
19	Write Final Assembly Number
20	Read Long Tag
21	Read Unique Identifier Associated With Long Tag
22	Write Long Tag

HART Common Practice Commands Set

Command	Definition
33	Read Transmitter Variables
34	Write Damping Value
35	Write Range Values
36	Set Upper Range Value
37	Set Lower Range Value
38	Reset Configuration Changed Flag
39	EEPROM Control
40	Enter Exit Fixed Current Mode
41	Perform Transmitter Self Test
42	Perform Master Reset
43	Set PV Zero
44	Write PV Units
45	Trim DAC Zero
46	Trim DAC Gain
47	Write Transfer Function
48	Read Additional Transmitter Status
49	Write PV Sensor Serial Number
50	Read Dynamic Variable Assignments
51	Write Dynamic Variable Assignments
52	Set Transmitter Variable Zero
53	Write Transmitter Variable Units
54	Read Transmitter Variable Information
55	Write Transmitter Variable Damping Value
56	Write Transmitter Variable Sensor Serial Number
57	Read Unit Tag Descriptor Date
58	Write Unit Tag Descriptor Date
59	Write Number Of Response Preambles
60	Read Analog Channel and Percent of Range
61	Read Dynamic Variables and PV Analog Ch
62	Read Analog Channels
63	Read Analog Channel Information

Command	Definition
64	Write Analog Channel Additional Damping Value
65	Write Analog Channel Range Values
66	Enter/Exit Fixed Analog Channel Mode
67	Trim Analog Channel Zero
68	Trim Analog Channel Gain
69	Write Analog Channel Transfer Function
70	Read Analog Channel Endpoint Values
71	Lock Device
72	Squawk
73	Find Device
74	Read I/O System Capabilities
75	Poll Sub-Device
76	Read Lock Device State
79	Write Device Variable
80	Read Device Variable Trim Points
81	Read Device Variable Trim Guidelines
82	Write Device Variable Trim Point
83	Reset Device Variable Trim
105	Read Burst Mode Configuration
106	Flush Delayed Responses
107	Write Burst Device Variables
108	Write Burst Mode Command Number
109	Burst Mode Control
110	Read All Dynamic Variables

3.4.10 Int. DB Address

0 to 3999

This field specifies the internal database register where the integer or packed ASCII string values returned by the command will be placed.

If the Floating Point Word Count parameter is "-1", then all the data returned by the HART command will be placed in this address without any formatting.

3.4.11 Int Word Count

0 to 125

This parameter specifies the number of words from the integer or packed ASCII string data returned by a HART command that will be placed on the Virtual Database. If this parameter is "0", no data will be written to the Database.

3.4.12 Swap Code

0, 1, 2, 3

This parameter defines the byte order of each four-byte group of data received. This parameter is helpful when dealing with floating-point or other multi-register values, as there is no standard byte order for storing these data types. The following table describes the values and their associated operations:

Swap Code	Description
0	None - No Change is made in the byte ordering (1234 = 1234)
1	Words - The words are swapped (1234=3412)
2	Words & Bytes - The words are swapped then the bytes in each word are swapped (1234=4321)
3	Bytes - The bytes in each word are swapped (1234=2143)

3.4.13 Use Long

0 or 1

This parameter defines if the command will be executed with short or long address. If the value is "0", then the configured command will be executed using the Short Address specified. If the value is "1" then the specified Short Address will be used only to ask for the long address and that will be used to execute the configured command.

3.4.14 Enable DB Address

0 to 3999

This field specifies the internal database register to be used to enable the execution of a command. This parameter is only used if "Enable" is "4" or "5". If the value of this database register is "-1", then the command will be executed, otherwise it will not. If the "Enable" value is "5", then after the successful execution of the command this value will become "0"

3.4.15 Done DB Address

-1 to 3999

This field specifies the internal database register to be used to signal the successful execution of a command. When a command is successfully executed a "-1" is written to this register. This "Done DB Address" can be shared with the "Enable DB Address" of another command to do a chained command execution.

3.4.16 Write DB Address

-1 to 3999

This field specifies the internal database register to be as a source of data for HART command which includes data. It is possible to include data with every HART command, but it depends of the command and of the device if it will accept this data.

If this value is "-1", it indicates that there will not be data with the command or that it will not come from database.

3.4.17 Swap Code

0, 1, 2, 3

This parameter defines the byte order of each four-byte group of data received. This parameter is helpful when dealing with floating-point or other multi-register values, as there is no standard byte order for storing these data types. The following table describes the values and their associated operations:

Swap Code	Description
0	None - No Change is made in the byte ordering (1234 = 1234)
1	Words - The words are swapped (1234=3412)
2	Words & Bytes - The words are swapped then the bytes in each word are swapped (1234=4321)
3	Bytes - The bytes in each word are swapped (1234=2143)

3.4.18 Byte Count

0 to 250

This parameter specifies the number of bytes to be sent to a HART device in the command. If the command has no data then this value should be "0".

If the value of this field is different of "0" and "Write DB Address" is different of "-1" then the data for the command will be taken from the Virtual Database. If the value of this field is different of "0" and "Write DB Address" is "-1" then the data for the command will be from the "Fixed Data" field for the command.

3.4.19 Fixed Data

Up to 250 HEX values separated by space

This parameter is a string of HEX values to be sent with the HART command. There should be at least the number of bytes specified in the "Byte Count" parameter. The bytes should be written in hexadecimal format and separated by a space. This data will be sent if the Parameter "Write DB Address" is "-1" and "Byte Count" is greater than "0", and it will be sent in the same order that they are written.

3.5 Data Map

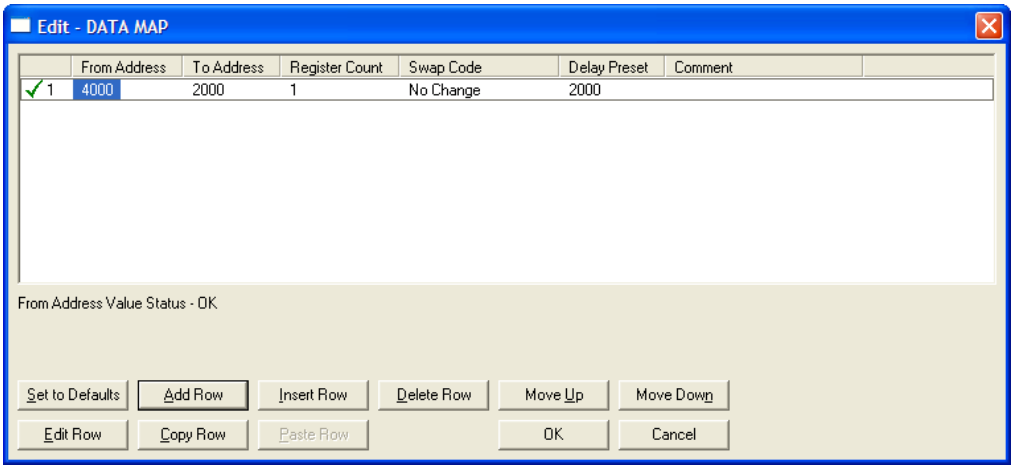
The **[DATA MAP]** section allows you to copy data between areas in the module's internal database.

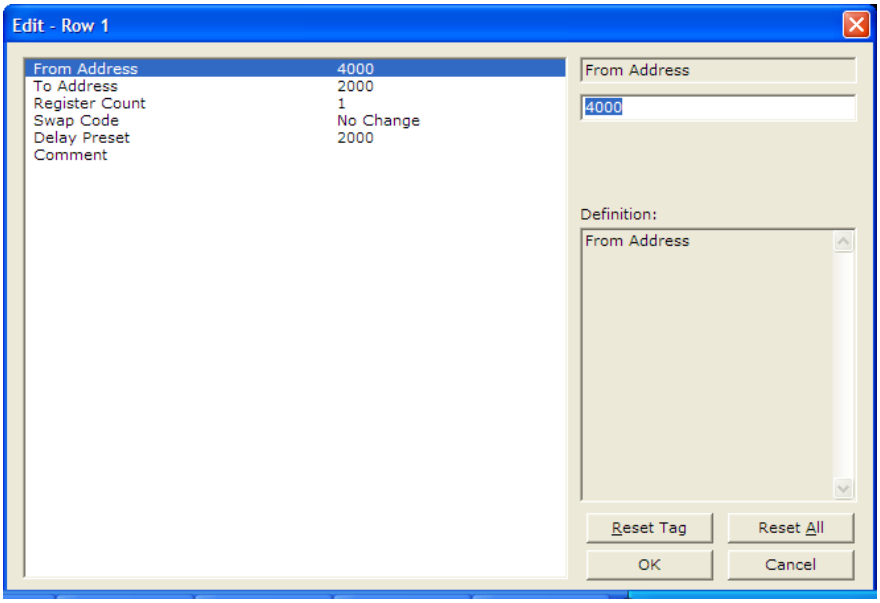
You can copy to 100 registers at a time, and you can configure up to 200 separate copy commands.

For example, you can copy data from the error or status tables in upper memory to internal database registers in the User Data memory area.

You can also rearrange the byte and/or word order during the copy process so that data such as floating-point values can be converted to the correct format for a specific protocol.

You can also use the Data Map to condense widely dispersed data into one contiguous data block, making it easier to access.





3.5.1 Internal Database Re-mapping

Depending on the application, you may need to copy data from one section of the module's internal database to another section. The **[Data Map]** section of the CFG file allows a user to selectively copy data registers, one register up to 100 registers at a time, from one internal database to another. Up to 200 entries can be made in the **[Data Map]** section, providing a wide and powerful range of functionality.

3.5.2 From Address

0 to 3999

This field specifies the internal database register to copy from. This address can range from the Data area as well as the Status Data Area of the product

3.5.3 To Address

0 to 3999

The destination for the copy is always going to be the Register Data area.

3.5.4 Register Count

1 to 100

This parameter specifies the number of registers to copy.

3.5.5 Swap Code

0, 1, 2, 3

There may be a need to swap the order of the bytes in the registers during the copy process in order to change from alignment of bytes between dissimilar protocols. This parameter is helpful when dealing with floating-point or other multi-register values, as there is no standard method of storage of these data types in slave devices.

The following table defines the values and their associated operations:

Swap Code	Description
0	None - No Change is made in the byte ordering (1234 = 1234)
1	Words - The words are swapped (1234=3412)
2	Words & Bytes - The words are swapped then the bytes in each word are swapped (1234=4321)
3	Bytes - The bytes in each word are swapped (1234=2143)

3.5.6 Delay Preset

This parameter sets an interval for each [Data Map] copy operation. The value you put for the Delay Preset is not a fixed amount of time. It is the number of firmware scans that must transpire between copy operations.

The firmware scan cycle can take a variable amount of time, depending on the level of activity of the protocol drivers running on the ProLinx gateway and the level of activity on the gateway's communications ports. Each firmware scan can take from 1 to several milliseconds to complete. Therefore, [Data Map] copy operations cannot be expected to happen at regular intervals.

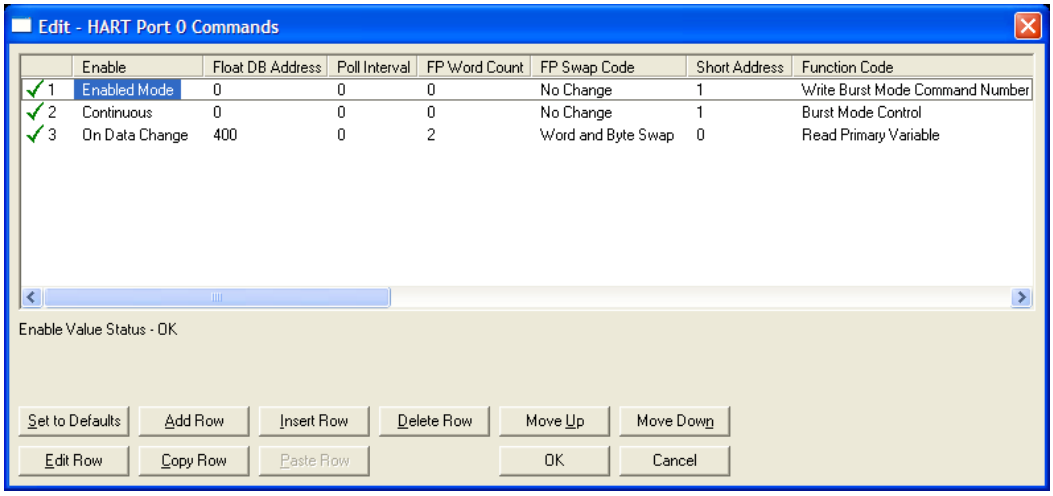
If multiple copy operations (several rows in the [Data map] section) happen too frequently or all happen in the same update interval, they could delay the process scan of the gateway protocols, which could result in slow data updates or missed data on communications ports. To avoid these potential problems, you should set the Delay Preset to different values for each row in the [Data Map] section and set them to higher, rather than lower, numbers.

For example, Delay Preset values below 1000 could begin to cause a noticeable delay in data updates through the communications ports. And you should not set all Delay Presets to the same value. Instead, use different values for each row in the [Data Map] such as 1000, 1001, and 1002 or any other different Delay Preset values you like. This will prevent the copies from happening concurrently and prevent possible process scan delays.

3.6 HART Command Entry Formats

Refer to HART Command Support (page 34) for a complete discussion of the HART commands supported by the module, and the structure and content of the data returned for each command.

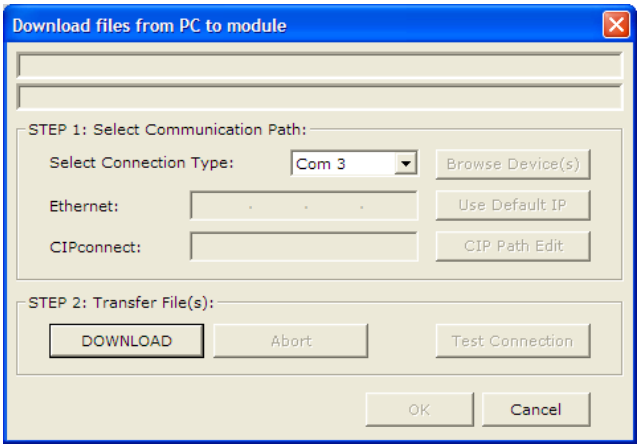
The following illustration shows a command list section of the CFG file:



3.7 Downloading a File from PC to the Gateway

To download a file from the Configuration Builder to the gateway:

1. Verify that your PC is connected to the gateway with a null-modem serial cable connected to the serial port on your PC and the serial port on the gateway
2. Open the **PROJECT** menu, and then choose **MODULE.**
3. On the **MODULE** menu, choose **DOWNLOAD.** Wait while ProSoft Configuration scans for communication ports on your PC. When the scan is complete, the **DOWNLOAD** dialog box opens.



4. Select the port to use for the download.
5. Click the **DOWNLOAD** button.

4 Error/Status Data

In This Chapter

- HART LED Indicators 43
- Viewing Error and Status Data 43
- Configuration Error Word Table 43
- Port 0 General Status Data 44
- Port 1 General Status Data 44
- Error/Status Data Structure 45
- Module Error Codes 47

The module error/status data areas are discussed in this section. The module contains three areas related to this data. The user defines the location of these data sets in the virtual database of the module. The error/status data contains module data, the six command error list data sets contain the errors associated with each respective command list and the four slave status list tables contain the communication status of each port's slave devices.

4.1 HART LED Indicators

LED	State	Description
CH1 to CH4	Green Flashing	The module either sending or receiving data over that channel.
	Off	The module is waiting to receive data on that channel.

4.2 Viewing Error and Status Data

The following topics list the register addresses that contain error and status data. You use the Database View option to view the contents of these registers. Refer to the *ProLinx Reference Guide* for detailed information on viewing error and status registers.

4.3 Configuration Error Word Table

4.3.1 HART Configuration Error Word

Bit	Code	Description
0	0x0001	Enabled not set to Y or N
1	0x0002	Enable Handheld not set to Y or N
2	0x0004	Primary Master not set to Y or N

Bit	Code	Description
3	0x0008	Invalid Preambles (1 to 50)
4	0x0010	Invalid Short Address Retries (0 to 50)
5	0x0020	Invalid Long Address Retries (0 to 50)
6	0x0040	Invalid Retries After Error (0 to 50)
7	0x0080	Invalid Poll Time After Error (0 to 10000)
8	0x0100	Invalid DB Address Status
9	0x0200	Invalid Command Count
10	0x0400	Memory Error in allocating commands
11	0x0800	Memory Error in allocating command fixed data
12	0x1000	Memory Error in allocating TX/RX buffers
13	0x2000	HART Board not found
14	0x4000	Cannot initialize HART channel
15	0x8000	reserved

4.4 Port 0 General Status Data

Status Register	Description
10700	State
10701	Comm State
10702	Device Status (bit mapped)
10703	Device Poll List (bit mapped)
10704	Device With Long Address (bit mapped)
10705	Current Command
10706	Command Request Count
10707	Command Response Count
10708	Configuration Error Word
10709	Current Error Code
10710	Last Error Code
10711 to 10799	No Valid Data

4.5 Port 1 General Status Data

Status Register	Description
10900	State
10901	Comm State
10902	Device Status (bit mapped)
10903	Device Poll List (bit mapped)
10904	Device With Long Address (bit mapped)
10905	Current Command
10906	Command Request Count
10907	Command Response Count

Status Register	Description
10908	Configuration Error Word
10909	Current Error Code
10910	Last Error Code
10911 to 10999	No Valid Data

4.5.1 General Status Data (Ports 2 through 7)

The following table lists the register address ranges for ports 2 through 7. The register descriptions are the same as listed in the previous table.

Port	Address Range
2	11100 to 11299
3	11300 to 11499
4	11500 to 11699
5	11700 to 11899
6	11900 to 12099
7	12100 to 12299

4.6 Error/Status Data Structure

The error/status data table is located at the virtual address assigned by the user. If the address is set to -1 or the frequency parameter is set to 0, the data will not be placed in the database. It will only be available through the Configuration/Debug Port. If valid address and frequency values are assigned, the module will update the data area.

The data area will be initialized with zeros whenever the processor is initialized. This occurs during a cold-start (power-on), reset (reset push-button pressed) or a warm-boot operation (commanded or loading of new configuration).

The following table shows the structure of the 44-word error/status data area.

Word	Description
HART CHANNEL 0	
16	Number of Command Requests
17	Number of Command Responses
18	Devices in Poll
19	Devices Status
20	Configuration Error
21	Current Error
22	Last Error
HART CHANNEL 1	
23	Number of Command Requests
24	Number of Command Responses
25	Devices in Poll
26	Devices Status

Word	Description
27	Configuration Error
28	Current Error
29	Last Error
HART CHANNEL 2	
30	Number of Command Requests
31	Number of Command Responses
32	Devices in Poll
33	Devices Status
34	Configuration Error
35	Current Error
36	Last Error
HART CHANNEL 3	
37	Number of Command Requests
38	Number of Command Responses
39	Devices in Poll
40	Devices Status
41	Configuration Error
42	Current Error
43	Last Error

4.6.1 HART Command List Error Data

Each command in the command list for each HART channel has a word value for a status/error code. This error data list can be read using the Configuration/Debug Port and can be placed in the module's internal database. Accessing the Debug capabilities of the module is accomplished easily by connecting a PC to the Debug port and loading a terminal program such as ProSoft Configuration Builder or Hyperterminal.

This status/error code is the first word of the Integer Data Block returned from every HART command executed. This word has information about the execution of the command by the HART device.

Refer to later sections containing Error Codes to interpret the status/error codes present in the integer data area.

Port 0 Command List Errors

Status Register	Description
10800	Command List Errors
…	
…	
10899	

Port 1 Command List Errors

Port 1 Command List errors are found in registers 11000 through 11099.

4.6.2 Slave List Status

The configuration parameter "DB Address Status" defines the register address in the virtual database where the status data for each HART channel will be placed. This word has one bit for each HART device and if this bit is in "1" it means that the corresponding HART device is not answering to the poll.

Bit	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
HART Device	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	Res

The bit 0 of the "Slave List Status" is reserved for future use and is always 0.

4.7 Module Error Codes

The module error codes are listed in this section. Error codes returned from the HART device are placed at the first word of the integer data block in the Virtual Database. The error codes are formatted in the word as follows: If the most-significant bit of the word contains "1", then the most significant byte has a communication error code. The least-significant byte of the word will contain "0".

If the most-significant bit of the word contains "0", the most significant byte contains a command error code. In this case, the least-significant byte contains a device malfunction information.

If this word value is "-1" (or 0xFFFF), it means that the command timed out.

Use the error codes returned for each command in the list to determine the success or failure of the command. If the command fails, use the error code to determine the cause of failure.

4.7.1 Protocol Error Codes

These are error codes that are part of the HART protocol. The standard HART error codes are shown in the following tables:

Error Code Word

First Byte								Second Byte							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0

Bit 7 of First Byte = 1 **COMMUNICATION ERROR**	
First Byte	
Bit 6	Parity Error
Bit 5	Overrun Error
Bit 4	Framing Error

Bit 7 of First Byte = 1	
COMMUNICATION ERROR	
Bit 3	Checksum Error
Bit 2	Reserved
Bit 1	Rx Buffer Overflow
Bit 0	Undefined
Second Byte	
Bit 0 To Bit 7	All 0

Bit 7 of First Byte = 0	
Command Error	
First Byte	
Bits 6 To 0 (not Bit-mapped):	
0	No Error
1	Undefined
2	Invalid Selection
3	Passed Parameter Too Large
4	Passed Parameter Too Small
5	Too Few Data Bytes Received
6	Transmitter-specific Command Error
7	In Write-protect Mode
8 to 15	Command Specific Errors (see Below)
16	Access Restricted
32	Device Is Busy
64	Command Not Implemented
Second Byte	
Bit 7	Device Malfunction
Bit 6	Configuration Changed
Bit 5	Cold Start
Bit 4	Unused
Bit 3	Output Current Fixed
Bit 2	Analog Output Saturated
Bit 1	Variable (not Primary) Out Of Limits
Bit 0	Primary Variable Out of Limits

Command Specific Errors	
8	Update Failed
	Update In Progress
	Set to Nearest Possible Value
9	Applied Process Too High
	Lower Range Value Too High
	Not in Fixed Current Mode
10	Applied Process Too Low
	Lower Range Value Too Low
	Multi-drop Not Supported
11	In Multi-drop Mode
	Invalid Transmitter Variable Code
	Upper Range Value Too High
12	Invalid Unit Code
	Upper Range Value Too Low
13	Both Range Values Out of Limits
14	Pushed Upper Range Value Over Limit
	Span Too Small

5 Reference

In This Chapter

- HART Universal Commands 51
- HART Common Practice Commands 64
- ProLinx HART Field Connections 93
- HART Status Data Map 102
- Module Status Values 105
- Module Status Data Map 107
- Virtual Addresses Assigned to Status Data Areas 108

5.1 HART Universal Commands

COMMAND 00 - Read Unique Identifier

Description

This command gets the long address of the HART device plus other manufacturer information like Manufacturer ID, Device Type Code, Software Revision, Hardware Revision, and so on.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Constant "254"	Manufacturer Identification Code
2	Manufacturer Device Type Code	Number of Preambles
3	Universal Command Revision	Transmitter Specific Command Revision
4	Software Revision	Hardware Revision
5	Device Function Flags	Device ID Number 1
6	Device ID Number 2	Device ID Number 3

COMMAND 01 - Read Primary Variable

Description

This command gets the device Primary Variable and the Primary Variable Units

Write Parameters

NONE

Floating Point Data Returned

Word	High Byte	Low Byte
0	Primary Variable Value	
1		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Primary Variable Units Code	0

COMMAND 02 - Read Current And Percent Of Range

Description

This command gets the current of the loop that is forced by the HART device and the Percent of Range of the Current.

Write Parameters

NONE

Floating Point Data Returned

Word	High Byte	Low Byte
0	Current (mA)	
1		
2	Percent of Range	
3		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 03 - Read Dynamic Variables

Description

This command gets the current and four (predefined) dynamic Variables.

Write Parameters

NONE

Floating Point Data Returned

Word	High Byte	Low Byte
0	Current (mA)	
1		
2	Primary Variable	
3		
4	Second Variable	
5		
6	Third Variable	
7		
8	Fourth Variable	
9		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Primary Variable Units Code	Second Variable Units Code
2	Third Variable Units Code	Fourth Variable Units Code

COMMAND 06 - Write Polling Address

Description

This command sets the polling address of a HART device. Extreme care should be taken when you use this command because you can loose the communication with the device.

Write Parameters

Word	High Byte	Low Byte
0	Polling Address	Polling Address

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Polling Address	0

COMMAND 12 - Read Message

Description

This command reads an ASCII message contained in the HART Device and written by the Write Message command 17.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Message ASCII Character 0	Message ASCII Character 1
2	Message ASCII Character 2	Message ASCII Character 3
.	.	
.	.	
.	.	
14	Message ASCII Character 28	Message ASCII Character 29
15	Message ASCII Character 30	Message ASCII Character 31

COMMAND 13 - Read Tag, Descriptor and Date

Description

This command reads an ASCII Tag which identifies the device, an ASCII descriptor of the device and the last Date it has been configured.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	TAG ASCII Character 0	TAG ASCII Character 1
2	TAG ASCII Character 2	TAG ASCII Character 3
3	TAG ASCII Character 4	TAG ASCII Character 5
4	TAG ASCII Character 6	TAG ASCII Character 7
5	Descriptor ASCII Character 0	Message ASCII Character 1
.	.	
.	.	
.	.	
12	Descriptor ASCII Character 14	Message ASCII Character 15
13	Date	Date
14	Date	0

COMMAND 14 - Read PV Sensor Info

Description

This command gets information about the Primary Variable sensor, like limits and span.

Write Parameters

NONE

Floating Point Data Returned

Word	High Byte	Low Byte
0	Upper Sensor Limit	
1		
2	Lower Sensor Limit	
3		
4	Minimum Span	
5		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Sensor Serial Number 0	Sensor Serial Number 1
2	Sensor Serial Number 2	Unit Codes for Sensor Limits and Span

COMMAND 15 - Read Output Information

Description

This command gets information about the Primary Variable Output Information.

Write Parameters

NONE

Floating Point Data Returned

Word	High Byte	Low Byte
0	Upper Range Value	
1		
2	Lower Range Value	
3		
4	Damping Value (Sec)	
5		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Alarm Select Code	Transfer Function Code
2	Primary Variable Range Units Code	Write-Protect Code
2	Private-Label Distributor Code	0

COMMAND 16 - Read Final Assembly Number

Description

This command reads the final assembly number of the HART device.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Final Assembly Number 0	Final Assembly Number 1
2	Final Assembly Number 2	0

COMMAND 17 - Write Message

Description

This command writes an ASCII message contained in the HART Device and that can be read with command 12.

Write Parameters

Word	High Byte	Low Byte
0	Packed ASCII Message Byte 0	Packed ASCII Message Byte 1
1	Packed ASCII Message Byte 2	Packed ASCII Message Byte 3
.	.	
.	.	
.	.	
11	Packed ASCII Message Byte 22	Packed ASCII Message Byte 23

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 18 - Write Tag, Descriptor and Date

Description

This command writes an ASCII Tag which identifies the device, an ASCII descriptor of the device and the last Date it has been configured.

Write Parameters

Word	High Byte	Low Byte
0	Packed ASCII TAG Byte 0	Packed ASCII TAG Byte 1
1	Packed ASCII TAG Byte 2	Packed ASCII TAG Byte 3
2	Packed ASCII TAG Byte 4	Packed ASCII TAG Byte 5
3	Packed ASCII Descriptor Byte 0	Packed ASCII Descriptor Byte 1
.	.	
.	.	
.	.	
8	Packed ASCII Descriptor Byte 10	Packed ASCII Descriptor Byte 11
9	Date	Date
10	Date	0

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	TAG ASCII Character 0	TAG ASCII Character 1
2	TAG ASCII Character 2	TAG ASCII Character 3
3	TAG ASCII Character 4	TAG ASCII Character 5
4	TAG ASCII Character 6	TAG ASCII Character 7
5	Descriptor ASCII Character 0	Message ASCII Character 1
.	.	
.	.	
.	.	
12	Descriptor ASCII Character 14	Message ASCII Character 15
13	Date	Date
14	Date	0

COMMAND 19 - Write Final Assembly Number

Description

This command writes the final assembly number of the HART device.

Write Parameters

Word	High Byte	Low Byte
0	Final Assembly Number 0	Final Assembly Number 1
1	Final Assembly Number 2	Final Assembly Number 2

Floating Point Data Returned:

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Final Assembly Number 0	Final Assembly Number 1
2	Final Assembly Number 2	0

5.2 HART Common Practice Commands

COMMAND 33 - Read Transmitter Variables

Description

This command gets four user selected dynamic Variables.

Write Parameters

Word	High Byte	Low Byte
0	Transmitter Variable Code For Slot 0	Transmitter Variable Code For Slot 1
1	Transmitter Variable Code For Slot 2	Transmitter Variable Code For Slot 3

Floating Point Data Returned

Word	High Byte	Low Byte
0	Variable for Slot 0	
1		
2	Variable for Slot 0	
3		
4	Variable for Slot 2	
5		
6	Variable for Slot 3	
7		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Transmitter Variable Code For Slot 0	Units Code for Slot 0 Variable
2	Transmitter Variable Code For Slot 1	Units Code for Slot 1 Variable
3	Transmitter Variable Code For Slot 2	Units Code for Slot 2 Variable
4	Transmitter Variable Code For Slot 3	Units Code for Slot 3 Variable

COMMAND 34 - Write Damping Value

Description

This command writes the damping value of a HART device.

Write Parameters

Word	High Byte	Low Byte
0	Floating Point Damping Value (Sec)	
1		

Floating Point Data Returned

Word	High Byte	Low Byte
0	Floating Point Damping Value (Sec)	
1		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 35 - Write Range Values

Description

This command writes the Upper and Lower range of the Primary Variable

Write Parameters

Word	High Byte	Low Byte
0	Range Units Code	Floating Point Upper Range Value (Byte 0)
1	Floating Point Upper Range Value (Byte 1)	Floating Point Upper Range Value (Byte 2)
2	Floating Point Upper Range Value (Byte 3)	Floating Point Lower Range Value (Byte 0)
3	Floating Point Lower Range Value (Byte 1)	Floating Point Lower Range Value (Byte 2)
4	Floating Point Lower Range Value (Byte 3)	Floating Point Lower Range Value (Byte 3)

Floating Point Data Returned

Word	High Byte	Low Byte
0	Upper Range Value	
1		
2	Lower Range Value	
3		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Range Units Code	0

COMMAND 36 - Set Upper Range Value

Description

This command is similar in effect to push the SPAN button of the HART device but doing it remotely through the HART network.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 37 - Set Lower Range Value

Description

This command is similar in effect to push the ZERO button of the HART device but doing it remotely through the HART network.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 38 - Reset Configuration Changed Flag

Description

This command resets the status bit that indicates that configuration has been changed.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 39 - EEPROM Control

Description

This command operates over the EEPROM changing its settings.

Write Parameters

Word	High Byte	Low Byte
0	EEPROM Control Code	EEPROM Control Code

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	EEPROM Control Code	0

COMMAND 40 - Enter Exit Fixed Current Mode

Description

This command writes the damping value of a HART device.

Write Parameters

Word	High Byte	Low Byte
0	Floating Point Current (mA)	
1		

Floating Point Data Returned

Word	High Byte	Low Byte
0	Floating Point Current (mA)	
1		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 41 - Perform Transmitter Self Test

Description

This command starts the HART device Self Test to find if there is any problem with the device hardware.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 42 - Perform Master Reset

Description

This command performs a master reset in the HART device.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 43 - Set PV Zero

Description

This command forces the Primary Value to Zero.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 44 - Write PV Units

Description

This command changes the setting of the Primary Variable units.

Write Parameters

Word	High Byte	Low Byte
0	Primary Variable Units Code	Primary Variable Units Code

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Primary Variable Units Code	0

COMMAND 45 - Trim DAC Zero

Description

This command calibrates the device Digital to analog converter zero. This is done by writing the same current value that is measured in the loop.

Write Parameters

Word	High Byte	Low Byte
0	Floating Point measured current (mA)	
1		

Floating Point Data Returned

Word	High Byte	Low Byte
0	Floating Point Current (mA)	
1		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 46 - Trim DAC Gain

Description

This command calibrates the device Digital to analog converter gain. This is done by writing the same current value that is measured in the loop.

Write Parameters

Word	High Byte	Low Byte
0	Floating Point Measured Current (mA)	
1		

Floating Point Data Returned

Word	High Byte	Low Byte
0	Floating Point Current (mA)	
1		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 47 - Write Transfer Function

Description

This command changes the setting of the Transfer Function of the HART device.

Write Parameters

Word	High Byte	Low Byte
0	Transfer Function Code	Transfer Function Code

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Transfer Function Code	0

COMMAND 48 - Read Additional Transmitter Status

Description

This command gets extended information about the status of the Transmitter. This information is specific for each transmitter.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Additional Status (Byte 0)	Additional Status (Byte 1)
2	Additional Status (Byte 2)	Additional Status (Byte 3)
.	.	
.	.	
.	.	
13	Additional Status (Byte 24)	0

COMMAND 49 - Write PV Sensor Serial Number

Description

This command changes the sensor serial number of the Primary Variable.

Write Parameters

Word	High Byte	Low Byte
0	Sensor Serial Number (Byte 0)	Sensor Serial Number (Byte 1)
1	Sensor Serial Number (Byte 2)	Sensor Serial Number (Byte 2)

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Sensor Serial Number (Byte 0)	Sensor Serial Number (Byte 1)
2	Sensor Serial Number (Byte 2)	0

COMMAND 50 - Read Dynamic Variable Assignments

Description

This command gets the actual assignment of the Dynamic Variables returned with command 3.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Transmitter Variable Code For Primary Variable	Transmitter Variable Code For Second Variable
2	Transmitter Variable Code For Third Variable	Transmitter Variable Code For Fourth Variable

COMMAND 51 - Write Dynamic Variable Assignments

Description

This command sets the assignment of the Dynamic Variables returned with command 3.

Write Parameters

Word	High Byte	Low Byte
0	Transmitter Variable Code For Primary Variable	Transmitter Variable Code For Second Variable
1	Transmitter Variable Code For Third Variable	Transmitter Variable Code For Fourth Variable

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Transmitter Variable Code For Primary Variable	Transmitter Variable Code For Second Variable
2	Transmitter Variable Code For Third Variable	Transmitter Variable Code For Fourth Variable

COMMAND 52 - Set Transmitter Variable Zero

Description

This command forces a selected transmitter variable to zero.

Write Parameters

Word	High Byte	Low Byte
0	Transmitter Variable Code	Transmitter Variable Code

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Primary Variable Units Code	0

COMMAND 53 - Write Transmitter Variable Units

Description

This command changes a selected transmitter variable unit.

Write Parameters:

Word	High Byte	Low Byte
0	Transmitter Variable Code	Transmitter Variable Units Code

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Primary Variable Units Code	Transmitter Variable Units Code

COMMAND 54 - Read Transmitter Variable Information

Description

This command gets information about any selected transmitter variable sensor.

Write Parameters

Word	High Byte	Low Byte
0	Transmitter Variable Code	Transmitter Variable Code

Floating Point Data Returned

Word	High Byte	Low Byte
0	Transmitter Variable Upper Limit	
1		
2	Transmitter Variable Lower Limit	
3		
4	Transmitter Variable Damping Value (Sec)	
5		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Transmitter Variable Code	Sensor Serial Number 0
1	Sensor Serial Number 1	Sensor Serial Number 2
2	Unit Code for Limits	0

COMMAND 55 - Write Transmitter Variable Damping Value

Description

This command writes the Damping Value of a user selected transmitter variable.

Write Parameters

Word	High Byte	Low Byte
0	Transmitter Variable Code	Transmitter Variable Damping Value (Byte 0)
1	Transmitter Variable Damping Value (Byte 1)	Transmitter Variable Damping Value (Byte 2)
2	Transmitter Variable Damping Value (Byte 3)	Transmitter Variable Damping Value (Byte 3)

Floating Point Data Returned

Word	High Byte	Low Byte
0	Transmitter Variable Damping Value	
1		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Transmitter Variable Code	0

COMMAND 56 - Write Transmitter Variable Sensor Serial Number

Description

This command writes the Serial Number of a user selected transmitter variable.

Write Parameters

Word	High Byte	Low Byte
0	Transmitter Variable Code	Transmitter Variable Sensor Serial Number (Byte 0)
1	Transmitter Variable Sensor Serial Number (Byte 1)	Transmitter Variable Sensor Serial Number (Byte 2)

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Transmitter Variable Code	Transmitter Variable Sensor Serial Number (Byte 0)
2	Transmitter Variable Sensor Serial Number (Byte 1)	Transmitter Variable Sensor Serial Number (Byte 2)

COMMAND 57 - Read Unit Tag Descriptor Date

Description

This command reads an ASCII Tag which identifies the device, an ASCII descriptor of the device and the last Date it has been configured.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	TAG ASCII Character 0	TAG ASCII Character 1
2	TAG ASCII Character 2	TAG ASCII Character 3
3	TAG ASCII Character 4	TAG ASCII Character 5
4	TAG ASCII Character 6	TAG ASCII Character 7
5	Descriptor ASCII Character 0	Message ASCII Character 1
.	.	
.	.	
.	.	
12	Descriptor ASCII Character 14	Message ASCII Character 15
13	Date	Date
14	Date	0

COMMAND 58 - Write Unit Tag Descriptor Date

Description

This command writes an ASCII Tag which identifies the device, an ASCII descriptor of the device and the last Date it has been configured.

Write Parameters:

Word	High Byte	Low Byte
0	Packed ASCII TAG Byte 0	Packed ASCII TAG Byte 1
1	Packed ASCII TAG Byte 2	Packed ASCII TAG Byte 3
2	Packed ASCII TAG Byte 4	Packed ASCII TAG Byte 5
3	Packed ASCII Descriptor Byte 0	Packed ASCII Descriptor Byte 1
.	.	
.	.	
.	.	
8	Packed ASCII Descriptor Byte 10	Packed ASCII Descriptor Byte 11
9	Date	Date
10	Date	0

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	TAG ASCII Character 0	TAG ASCII Character 1
2	TAG ASCII Character 2	TAG ASCII Character 3
3	TAG ASCII Character 4	TAG ASCII Character 5
4	TAG ASCII Character 6	TAG ASCII Character 7
5	Descriptor ASCII Character 0	Message ASCII Character 1
.	.	
.	.	
.	.	
12	Descriptor ASCII Character 14	Message ASCII Character 15
13	Date	Date
14	Date	0

COMMAND 59 - Write Number Of Response Preambles

Description

This command sets the number of preambles that the HART slave will use in every command response.

Write Parameters

Word	High Byte	Low Byte
0	Number of Response Preambles	Number of Response Preambles

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Number of Response Preambles	0

COMMAND 108 - Write Burst Mode Command Number

Description

This command sets the command number that the HART device will use in Burst Mode.

Write Parameters

Word	High Byte	Low Byte
0	Burst Mode Command Number	Burst Mode Command Number

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Burst Mode Command Number	0

COMMAND 109 - Burst Mode Control

Description

This command sets the HART device Burst Mode.

Write Parameters

Word	High Byte	Low Byte
0	Burst Mode Control Code	Burst Mode Control Code

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Burst Mode Control Code	0

1 = ON

0 = Off

COMMAND 110 - Read All Dynamic Variables

Description

This command gets all dynamic Variables.

Write Parameters

NONE

Floating Point Data Returned

Word	High Byte	Low Byte
0	Primary Variable	
1		
2	Second Variable	
3		
4	Third Variable	
5		
6	Fourth Variable	
7		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Primary Variable Units Code	Second Variable Units Code
2	Third Variable Units Code	Fourth Variable Units Code

5.3 ProLinx HART Field Connections

HART field instruments are divided into four categories; A through D, depending on power requirements and whether the device sinks or sources a bias or operating current from the network. The following table defines the categories:

Type	Description
A	Type A field instruments sink direct current from the network and receive operating power from the network.
B	Type B field instruments sink direct current from the network but receive no operating power from the network.
C	Type C field instruments source direct current to the network and receive no operating power from the network.
D	Type D field instruments neither source nor sink direct current from the network, nor receive operating power from the network.

On a given network, A, B, and D devices may be combined. C and D devices may also be combined. A or B field instruments should not be combined with C devices.

5.3.1 Network Power Supply Requirements

Type	Network Power Supply
A	Required
B	Required
C	Must not be used.
D	Not required, but may be used.

Note: The ProSoft 5107/5207 HART interface may be used with any HART field device.

Connections for HART Devices (Types A, B, C and D)

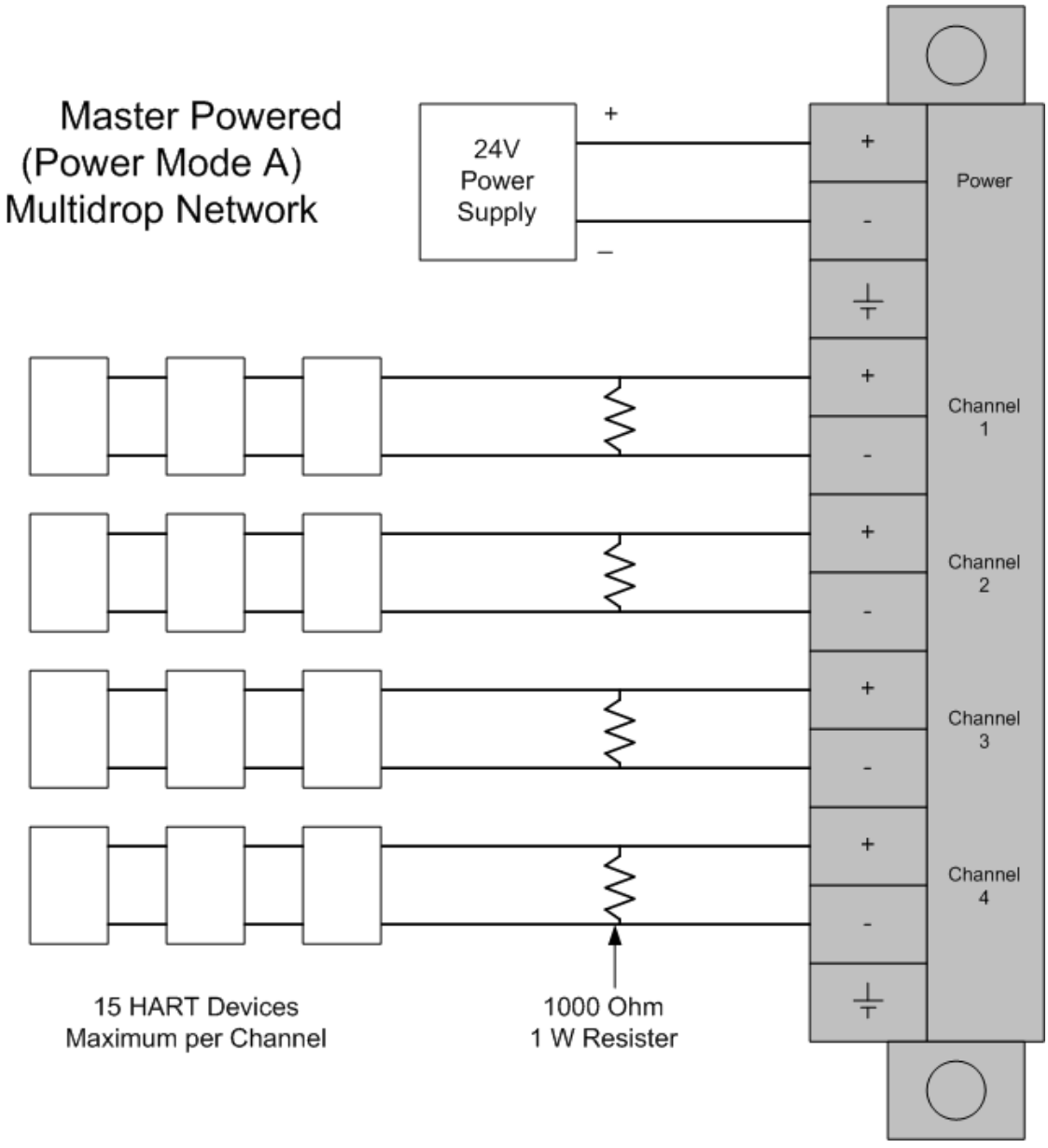
The ProLinx HART interface card has power supply input terminals for powering the devices in a network. This external power supply must be properly sized to supply current to all the HART devices in the network. A good rule of thumb is that each HART device may require as much as 20mA. Therefore, if you plan to place 10 HART devices in a network, you must provide a 24VDC power supply that can supply at least 200mA of output current.

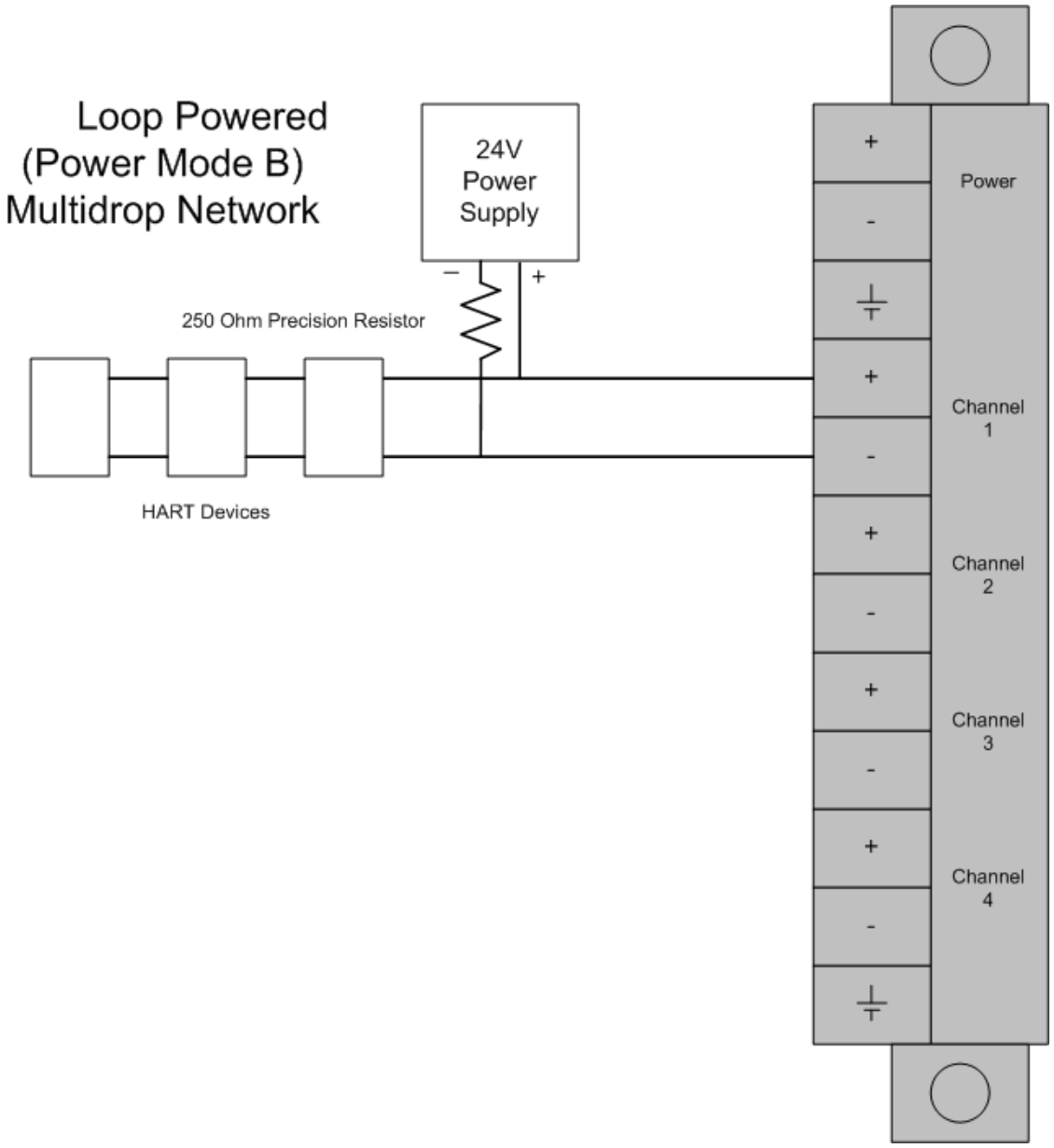
WARNING: Whenever the HART module is used in multi-drop mode (2 to 15 instruments per channel), each of the instruments 4 to 20mA analog signal is lost.

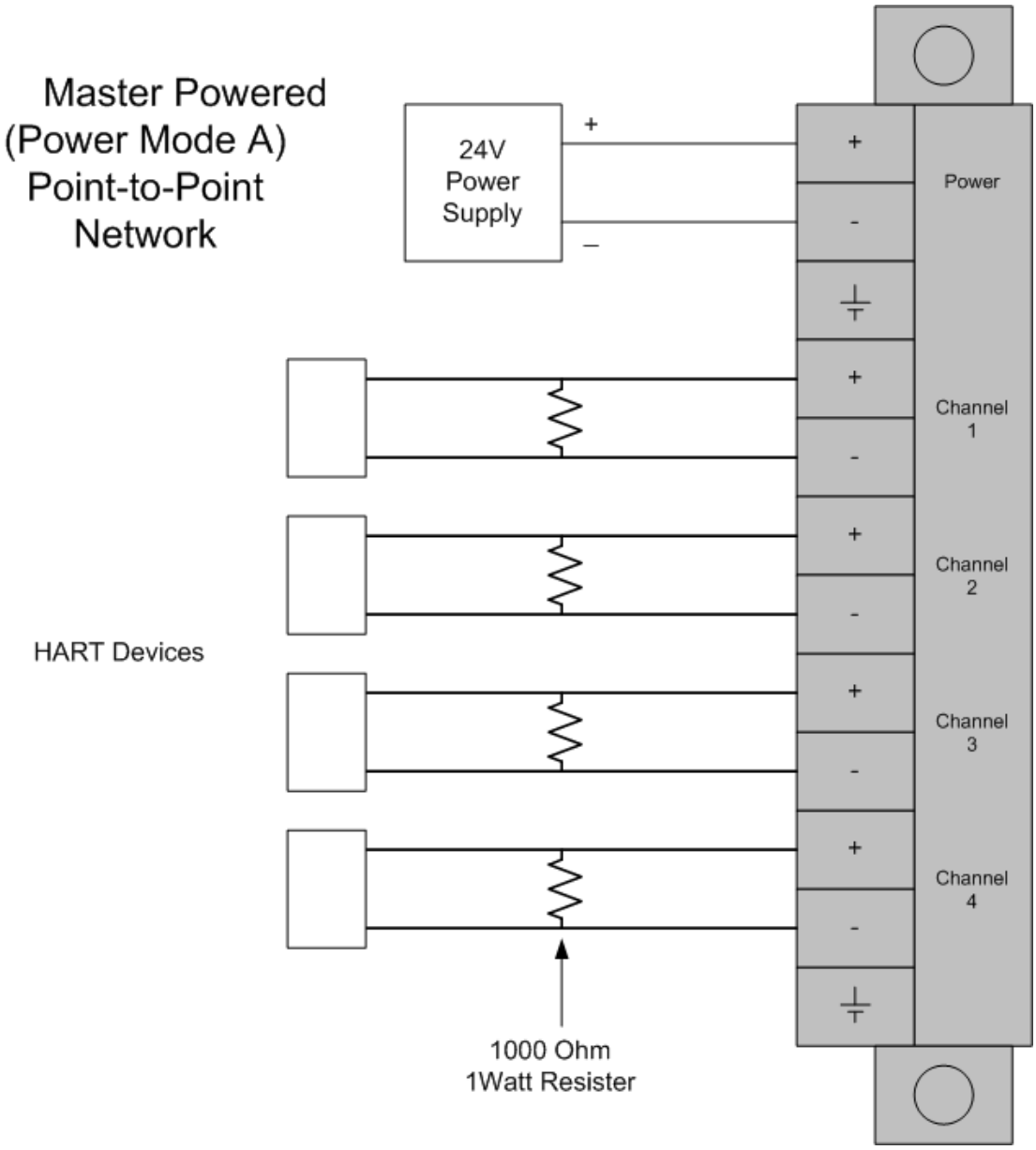
Notes

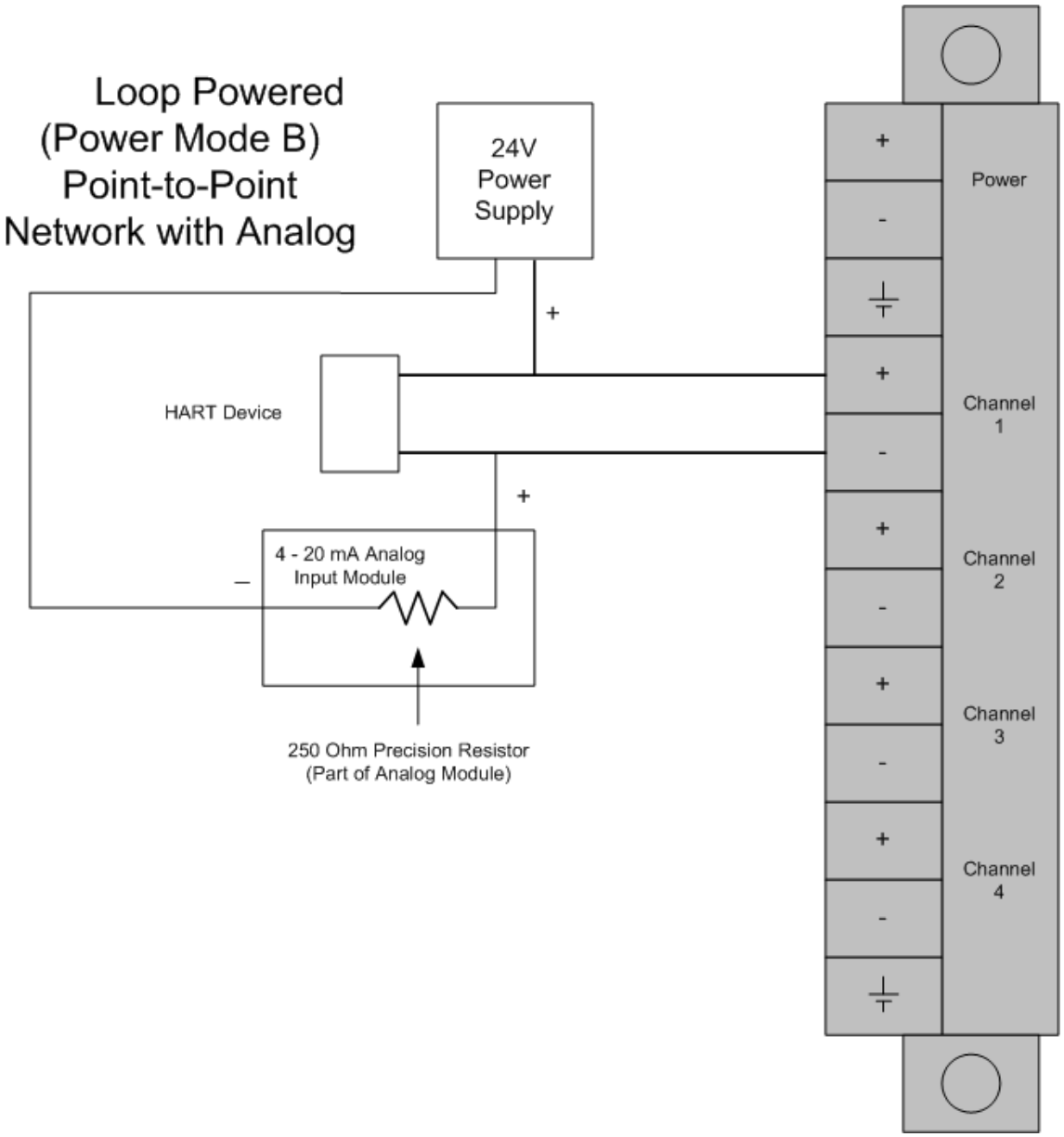
1. All four channels on the unit must be either Master Powered (Power Mode A) or must be Loop or Self powered (Power Mode B). You cannot mix Power Mode A and Power Mode B on the same unit. You can mix Loop powered and Self powered instruments on the same unit. However, you cannot mix Loop powered and Self powered instruments on the same channel.
2. For Master Powered, Multi-drop Mode and Point to Point Mode, a 1K, 1W resistor must be connected across the + and - input terminals of each HART channel. Resistors are supplied with each product.
3. When configuring loop powered instruments in a Power Mode B type multi-drop network, use only one power supply per HART channel if you wish to maintain channel to channel isolation. If channel to channel isolation is not required, the same power supply may be used for all four channels. However, a separate series resistor is required for each channel. An appropriately sized resistor must be connected in series with the power supply for each channel. The value and power rating of the resistor is dependant upon the number of instruments in the loop and the length and gauge of the pair of wires connecting the instruments to the unit. 250 Ohm, 3 Watt is a good, first choice value.
4. If field instrument wiring is shielded, terminate shields at the ground terminals of the HART connector. Do not terminate the shields at the instrument.

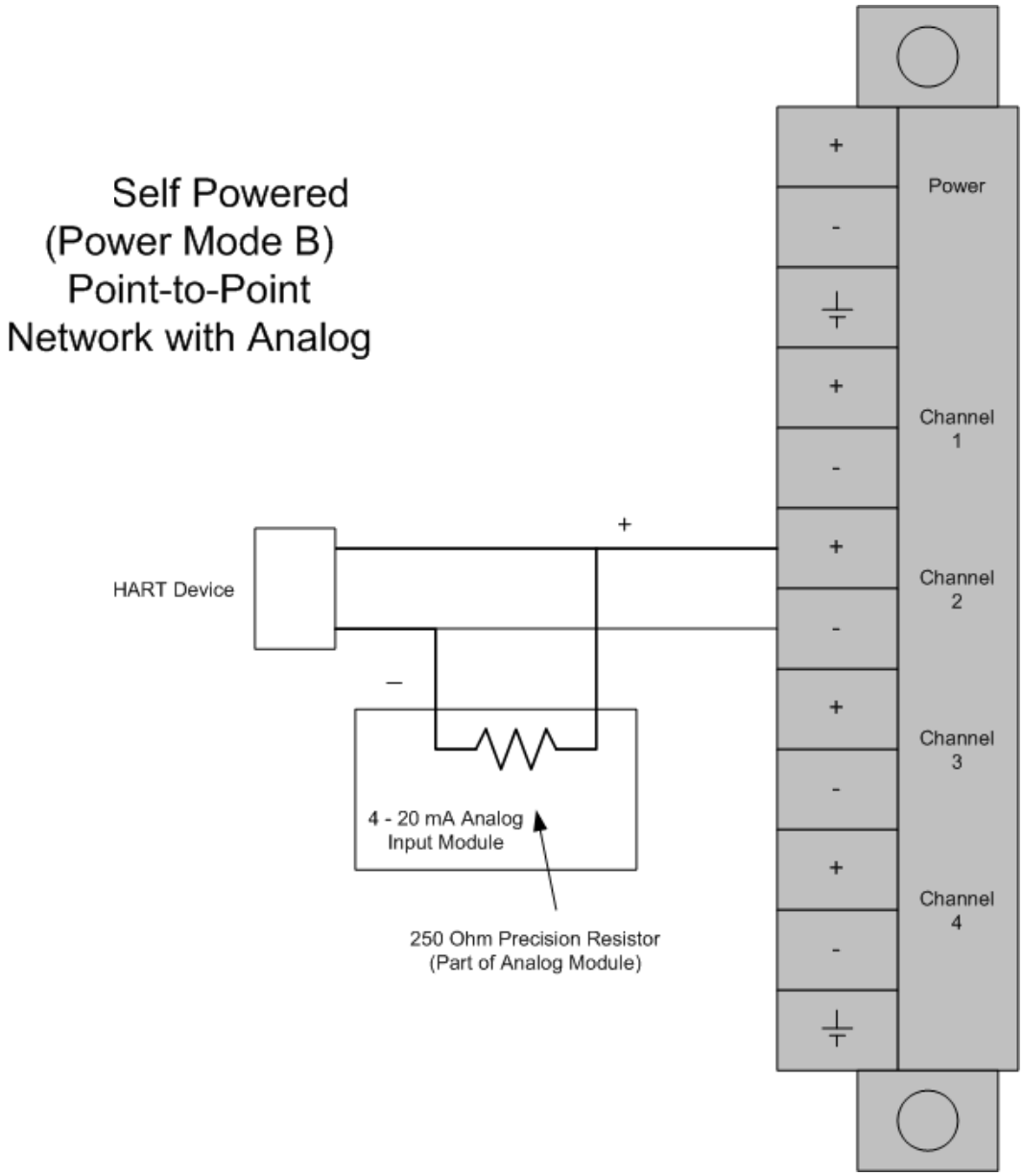
5 For multi-drop applications, the 1KΩ resistor should be normally used when one transmitter is connected to the port. If you increase the number of devices connected to a single port, you may need to reduce the size of the resistor.

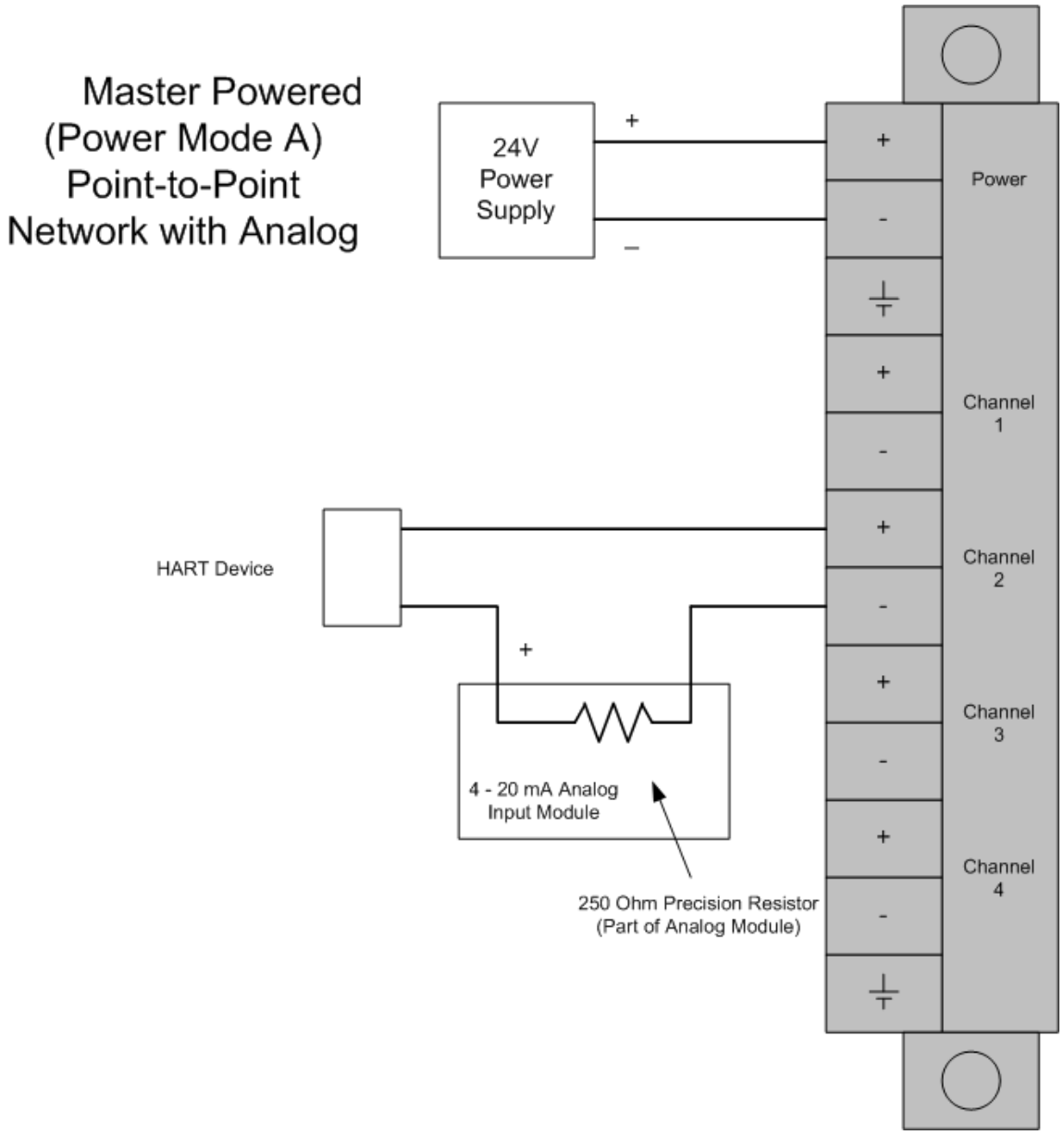



Loop Powered
(Power Mode B)
Multidrop Network
24V
Power
Supply
–
+
250 Ohm Precision Resistor
HART Devices
+
-
Power
+
-
Channel
1
+
-
Channel
2
+
-
Channel
3
+
-
Channel
4


Master Powered
(Power Mode A)
Point-to-Point
Network
24V
Power
Supply
+
–
+
-
Power
Channel
1
Channel
2
Channel
3
Channel
4
HART Devices
1000 Ohm
1Watt Resister


Loop Powered
(Power Mode B)
Point-to-Point
Network with Analog
24V
Power
Supply
+
HART Device
+
4 - 20 mA Analog
Input Module
–
250 Ohm Precision Resistor
(Part of Analog Module)
+
-
Power
+
-
Channel
1
+
-
Channel
2
+
-
Channel
3
+
-
Channel
4

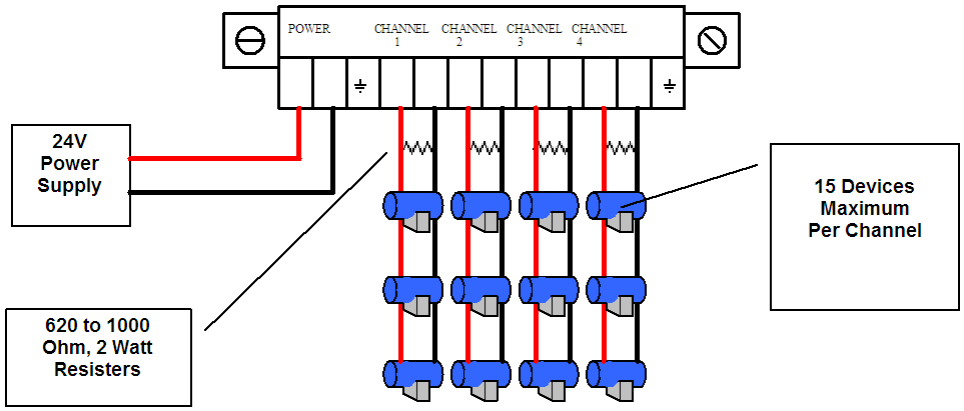

Self Powered
(Power Mode B)
Point-to-Point
Network with Analog
+
-
Power
+
-
Channel
1
+
-
Channel
2
+
-
Channel
3
+
-
Channel
4
HART Device
+
–
4 - 20 mA Analog
Input Module
250 Ohm Precision Resistor
(Part of Analog Module)


Master Powered
(Power Mode A)
Point-to-Point
Network with Analog
24V
Power
Supply
+
–
+
-
Power
Channel
1
Channel
2
Channel
3
Channel
4
HART Device
+
4 - 20 mA Analog
Input Module
250 Ohm Precision Resistor
(Part of Analog Module)

ProLinx HART Connection Diagram for Multiple Single and Loop-Powered Devices, Digital Signal Only (A, B, C, or D Types)

This type of connection is NOT recommended, but has been used to mix A, B, C, and D types of HART devices.

Note: This type of connection may have problems associated with the lowering of AC impedance, lower immunity to electrical noise, and lower supply voltage to A and B type devices.



5.3.2 Example Field Terminations

		Up to 15 instruments per channel	One instrument per channel	
		Multi-drop Mode (address 1 to 15)	**Point to Point Mode (address 0 to 15)**	**Point to Point Mode with Analog (address 0 only)**
Power Mode A 24VDC connected to HART power terminals 1 and 2 on terminal block	Master Powered instruments on all 4 channels	OK Install 250Ω 1KΩ	OK Install 1K resistor	OK
Power Mode B HART power terminals 1 and 2 on terminal block left open	Loop Powered instruments on 1 or more channels	OK	OK	OK - differential or single ended analog signal
	Self Powered instruments on 1 or more channels	Not possible	OK	OK -differential or single ended analog signal

5.4 HART Status Data Map

The word addresses in the following topics are virtual addresses. To view the contents of these registers, use the Data Map section (page 39) of the module configuration file to map these values into the 4000 word database.

5.4.1 Port 0 General Status Data

Status Register	Name	Description
10700	State	Port 0 state machine value (used for debugging)
10701	Comm State	Port 0 communication state machine value (used for debugging)
10702	Device Status (bit mapped)	Each bit in this word corresponds to a slave address on the network starting at bit 1 for slave address 1. Bit 0 is not used. If the bit is set, the slave is in error. If the bit is clear (0), the slave is not in error.
10703	Device Poll List (bit mapped)	Each bit in this word corresponds to a slave address on the network starting at bit 1 for slave address 1. Bit 0 is not used. If the bit is set, the slave is in the poll list. If the bit is clear (0), the slave is not in the poll list.
10704	Device With Long Address (bit map)	Each bit in this word corresponds to a slave address on the network starting at bit 1 for slave address 1. Bit 0 is not used. If the bit is set, the slave uses the long address. If the bit is clear (0), the slave does not use the long address.
10705	Current Command	This field contains the index of the current command to execute.
10706	Command Request Count	This field contains the total number of request messages issued on the port.
10707	Command Response Count	This field contains the total number of response messages received from devices on the network.
10708	Configuration Error Word	Configuration error word (see HART Configuration Error Word (page 43))
10709	Current Error Code	Current error code for port
10710	Last Error Code	Last error code reported for port
10711	No Valid Data	
…		
10799		

5.4.2 Port 0 Command Errors

Status Register	Description
10800	Command List Errors
…	
10899	

5.4.3 Port 1 General Status Data

Status Register	Name	Description
10900	State	Port 1 state machine value (used for debugging)
10901	Comm State	Port 1 communication state machine value (used for debugging)
10902	Device Status (bit mapped)	Each bit in this word corresponds to a slave address on the network starting at bit 1 for slave address 1. Bit 0 is not used. If the bit is set, the slave is in error. If the bit is clear (0), the slave is not in error.
10903	Device Poll List (bit mapped)	Each bit in this word corresponds to a slave address on the network starting at bit 1 for slave address 1. Bit 0 is not used. If the bit is set, the slave is in the poll list. If the bit is clear (0), the slave is not in the poll list.
10904	Device With Long Address (bit map)	Each bit in this word corresponds to a slave address on the network starting at bit 1 for slave address 1. Bit 0 is not used. If the bit is set, the slave uses the long address. If the bit is clear (0), the slave does not use the long address.
10905	Current Command	This field contains the index of the current command to execute.
10906	Command Request Count	This field contains the total number of request messages issued on the port.
10907	Command Response Count	This field contains the total number of response messages received from devices on the network.
10908	Configuration Error Word	Configuration error word (see HART Configuration Error Word (page 43))
10909	Current Error Code	Current error code for port
10910	Last Error Code	Last error code reported for port
10911	No Valid Data	
…		
10999		

5.4.4 Port 1 Command Errors

Status Register	Description
11000	Command List Errors
…	
11099	

5.4.5 Port 2 Data

Status Register	Description
11100	Same as above
…	
11299	

5.4.6 Port 3 Data

Status Register	Description
11300	Same as above
…	
11499	

5.4.7 Port 4 Data

Status Register	Description
11500	Same as above
…	
11699	

5.4.8 Port 5 Data

Status Register	Description
11700	Same as above
…	
11899	

5.4.9 Port 6 Data

Status Register	Description
11900	Same as above
…	
12099	

5.4.10 Port 7 Data

Status Register	Description
12100	Same as above
…	
12299	

5.5 Module Status Values

The word addresses in the following topics are virtual addresses. To view the contents of these registers, use the Data Map section (page 39) of the module configuration file to map these values into the 4000 word database.

5.5.1 Normal Operation

Status Register	Description
0x00	Interface operational

5.5.2 Interface Crash Codes

Status Register	Description
0x01	2-second interface timeout
0x02	Bad interface opcode
0x03	Interface data error
0x04	Interface test error
0x05	Interface x-fer done error
0x06	Bad interface path
0x07	Bad interface state
0x08	Bad interface length
0x09	Global data length error
0x0A	Global data address error
0X0B	Global data not present

5.5.3 Fatal Crash Codes

Status Register	Description
0x81	PROM checksum error
0x82	Internal RAM data test error
0x83	External RAM data test error
0x84	External RAM address test error
0x85	Bad confidence test index
0x86	External Int0 event error
0x87	External Int1 event error
0x88	DMA Int0 event error
0x89	Comm. Int event error
0x8A	Xmit-no good event error
0X8B	No response timeout MAC State
0X8C	No response timeout MAC idle
0X8D	Receive OK MAC state
0X8E	Transmit OK MAC state
0X8F	No receive buffer free

Status Register	Description
0X90	Bad input transfer length
0X91	Reserved rev buffer error
0X92	Bad trans control state
0X93	Bad word request bit
0X94	Node queue overflow
0X95	Bad data queue error
0X96	Empty data path error
0X97	Bad path search index
0X98	Bad data slave path

5.5.4 Peer Status Codes

Status Register	Description
0	Monitor link operation
32	Normal link operation
64	Never getting token
96	Sole station
128	Duplicate station

5.5.5 Global Out Update Status

Status Register	Description
0x01	Updating all OK
0x02	Not assigned
0x04	Not assigned
0x08	Global update timeout (not trasmitted in 500 milliseconds)
0x10	Global data not configured (length set to zero)
0x20	Not assigned
0x40	Invalid Global Data Length (Length > 32 words)
0x80	Not assigned

5.6 Module Status Data Map

The word addresses in the following topics are virtual addresses. To view the contents of these registers, use the Data Map section (page 39) of the module configuration file to map these values into the 4000 word database.

5.6.1 General Module Status Data

Status Register	Description
4000	Program Cycle Counter
4001	Product Name (ASCII)
4002	
4003	Revision (ASCII)
4004	
4005	Operating System Rev (ASCII)
4006	
4007	Production Run Number (ASCII)
4008	
4009	No Valid Data
…	
4019	

5.6.2 HTTP Port 80 Status

Status Register	Description
4020	Reserved
4021	Reserved
4022	Reserved
4023	Number of Request Packets
4024	Number of Response Packets
4025	Reserved
4026	Reserved
4027	Reserved
4028	Reserved
4029	Reserved

5.6.3 SNTP Client Status

Status Register	Description
4030	Time is valid
4031	Request count
4032	Response count
4033	Computation count
4034	Clock set count

Status Register	Description
4035	Timeout error count
4036	No Valid Data
…	
4039	

5.6.4 Wireless SNTP Client Status

Status Register	Description
4040	Time is valid
4041	Request count
4042	Response count
4043	Computation count
4044	Clock set count
4045	Timeout error count
4046	No Valid Data
…	
4049	

5.7 Virtual Addresses Assigned to Status Data Areas

Driver	Start Address	End Address	Reserved Length	Comment
Module	4000	4099	100	
MODBUS Plus	4100	4399	300	
MCM	4400	5999	1600	
MNET	6000	6299	300	
DFCM	6300	7899	1600	
DFNT	7900	8999	1100	
RIO adapter	9000	9099	100	
DNP Slave	9900	9999	100	
DNP Net Server	10000	10099	100	
IEC-101 Slave	10100	10199	100	
IEC-104 Server	10200	10299	100	
Profibus Slave	10300	10399	100	
Profibus Master	10400	10499	100	
Master	10500	10699	200	Cmds
HART	10700	12299	1600	
BACnet	12300	12499	200	
Radio	12500	12599	100	
Reserved	12600	12999	400	
ASCII	13000	13099	100	
Reserved	13100	13999	900	
IEC-103 Master	14000	14089	90	

Driver	Start Address	End Address	Reserved Length	Comment
Master	15000	15499	500	Cmds
DH485	14100	14199	100	
Master	14200	14299	100	Cmds
IEC-101 Master				
Master				Cmds
RIO Scanner				
ControlNet				
Reserved	15500	15999	500	
EGD	16000	17400	1400	Exchange status
Reserved	17500	17999	500	
EGD Wireless	18000	19400	1400	Exchange status
Reserved	19500	19899	400	
DFNT Wireless	19900	21000	1100	
Reserved	19500	65535	48036	

6 Support, Service & Warranty

In This Chapter

- How to Contact Us: Technical Support 111
- Return Material Authorization (RMA) Policies and Conditions 112
- LIMITED WARRANTY 113

ProSoft Technology, Inc. (ProSoft) is committed to providing the most efficient and effective support possible. Before calling, please gather the following information to assist in expediting this process:

1 Product Version Number
2 System architecture
3 Network details

If the issue is hardware related, we will also need information regarding:

1 Module configuration and contents of file
   - Module Operation
   - Configuration/Debug status information
   - LED patterns

2 Information about the processor and user data files as viewed through and LED patterns on the processor.
3 Details about the serial devices interfaced, if any.

6.1 How to Contact Us: Technical Support

Internet	Web Site: www.prosoft-technology.com/support
	E-mail address: support@prosoft-technology.com

Asia Pacific

+603.7724.2080, support.asia@prosoft-technology.com
Languages spoken include: Chinese, English

Europe (location in Toulouse, France)

+33 (0) 5.34.36.87.20, support.EMEA@prosoft-technology.com
Languages spoken include: French, English

North America/Latin America (excluding Brasil) (location in California)

+1.661.716.5100, support@prosoft-technology.com
Languages spoken include: English, Spanish
*For technical support calls within the United States, an after-*hours *answering system allows pager access to one of our qualified technical and/or application support engineers at any time to answer your questions.*

Brasil (location in Sao Paulo)

+55-11-5084-5178, eduardo@prosoft-technology.com
Languages spoken include: Portuguese, English

6.2 Return Material Authorization (RMA) Policies and Conditions

The following RMA Policies and Conditions (collectively, "RMA Policies") apply to any returned Product. These RMA Policies are subject to change by ProSoft without notice. For warranty information, see "Limited Warranty". In the event of any inconsistency between the RMA Policies and the Warranty, the Warranty shall govern.

6.2.1 All Product Returns:

a) In order to return a Product for repair, exchange or otherwise, the Customer must obtain a Returned Material Authorization (RMA) number from ProSoft and comply with ProSoft shipping instructions.
b) In the event that the Customer experiences a problem with the Product for any reason, Customer should contact ProSoft Technical Support at one of the telephone numbers listed above (page 111). A Technical Support Engineer will request that you perform several tests in an attempt to isolate the problem. If after completing these tests, the Product is found to be the source of the problem, we will issue an RMA.
c) All returned Products must be shipped freight prepaid, in the original shipping container or equivalent, to the location specified by ProSoft, and be accompanied by proof of purchase and receipt date. The RMA number is to be prominently marked on the outside of the shipping box. Customer agrees to insure the Product or assume the risk of loss or damage in transit. Products shipped to ProSoft using a shipment method other than that specified by ProSoft or shipped without an RMA number will be returned to the Customer, freight collect. Contact ProSoft Technical Support for further information.
d) A 10% restocking fee applies to all warranty credit returns whereby a Customer has an application change, ordered too many, does not need, and so on.

6.2.2 Procedures for Return of Units Under Warranty:

A Technical Support Engineer must approve the return of Product under ProSoft's Warranty:

a) A replacement module will be shipped and invoiced. A purchase order will be required.
b) Credit for a product under warranty will be issued upon receipt of authorized product by ProSoft at designated location referenced on the Return Material Authorization.

6.2.3 Procedures for Return of Units Out of Warranty:

a) Customer sends unit in for evaluation
b) If no defect is found, Customer will be charged the equivalent of $100 USD, plus freight charges, duties and taxes as applicable. A new purchase order will be required.

c) If unit is repaired, charge to Customer will be 30% of current list price (USD) plus freight charges, duties and taxes as applicable. A new purchase order will be required or authorization to use the purchase order submitted for evaluation fee.

The following is a list of non-repairable units:

- 3150 - All
- 3750
- 3600 - All
- 3700
- 3170 - All
- 3250
- 1560 - Can be repaired, only if defect is the power supply
- 1550 - Can be repaired, only if defect is the power supply
- 3350
- 3300
- 1500 - All

6.3 LIMITED WARRANTY

This Limited Warranty ("Warranty") governs all sales of hardware, software and other products (collectively, "Product") manufactured and/or offered for sale by ProSoft, and all related services provided by ProSoft, including maintenance, repair, warranty exchange, and service programs (collectively, "Services"). By purchasing or using the Product or Services, the individual or entity purchasing or using the Product or Services ("Customer") agrees to all of the terms and provisions (collectively, the "Terms") of this Limited Warranty. All sales of software or other intellectual property are, in addition, subject to any license agreement accompanying such software or other intellectual property.

6.3.1 What Is Covered By This Warranty

a) *Warranty On New Products*: ProSoft warrants, to the original purchaser, that the Product that is the subject of the sale will (1) conform to and perform in accordance with published specifications prepared, approved and issued by ProSoft, and (2) will be free from defects in material or workmanship; provided these warranties only cover Product that is sold as new. This Warranty expires three years from the date of shipment (the "Warranty Period"). If the Customer discovers within the Warranty Period a failure of the Product to conform to specifications, or a defect in material or workmanship of the Product, the Customer must promptly notify ProSoft by fax, email or telephone. In no event may that notification be received by ProSoft later than 39 months. Within a reasonable time after notification, ProSoft will correct any failure of the Product to conform to specifications or any defect in material or workmanship of the Product, with either new or used replacement parts. Such repair, including both parts and labor, will be performed at ProSoft's expense. All warranty service will be performed at service centers designated by ProSoft.

b) *Warranty On Services*: Materials and labor performed by ProSoft to repair a verified malfunction or defect are warranteed in the terms specified above for new Product, provided said warranty will be for the period remaining on the original new equipment warranty or, if the original warranty is no longer in effect, for a period of 90 days from the date of repair.

6.3.2 What Is Not Covered By This Warranty

a) ProSoft makes no representation or warranty, expressed or implied, that the operation of software purchased from ProSoft will be uninterrupted or error free or that the functions contained in the software will meet or satisfy the purchaser's intended use or requirements; the Customer assumes complete responsibility for decisions made or actions taken based on information obtained using ProSoft software.
b) This Warranty does not cover the failure of the Product to perform specified functions, or any other non-conformance, defects, losses or damages caused by or attributable to any of the following: (i) shipping; (ii) improper installation or other failure of Customer to adhere to ProSoft's specifications or instructions; (iii) unauthorized repair or maintenance; (iv) attachments, equipment, options, parts, software, or user-created programming (including, but not limited to, programs developed with any IEC 61131-3, "C" or any variant of "C" programming languages) not furnished by ProSoft; (v) use of the Product for purposes other than those for which it was designed; (vi) any other abuse, misapplication, neglect or misuse by the Customer; (vii) accident, improper testing or causes external to the Product such as, but not limited to, exposure to extremes of temperature or humidity, power failure or power surges; or (viii) disasters such as fire, flood, earthquake, wind and lightning.
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6.3.3 Disclaimer Regarding High Risk Activities

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6.3.5 Disclaimer of all Other Warranties

The Warranty set forth in What Is Covered By This Warranty (page 113) are in lieu of all other warranties, express or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose.

6.3.6 Limitation of Remedies **

In no event will ProSoft or its Dealer be liable for any special, incidental or consequential damages based on breach of warranty, breach of contract, negligence, strict tort or any other legal theory. Damages that ProSoft or its Dealer will not be responsible for included, but are not limited to: Loss of profits; loss of savings or revenue; loss of use of the product or any associated equipment; loss of data; cost of capital; cost of any substitute equipment, facilities, or services; downtime; the claims of third parties including, customers of the Purchaser; and, injury to property.

** Some areas do not allow time limitations on an implied warranty, or allow the exclusion or limitation of incidental or consequential damages. In such areas, the above limitations may not apply. This Warranty gives you specific legal rights, and you may also have other rights which vary from place to place.

6.3.7 Time Limit for Bringing Suit

Any action for breach of warranty must be commenced within 39 months following shipment of the Product.

6.3.8 No Other Warranties

Unless modified in writing and signed by both parties, this Warranty is understood to be the complete and exclusive agreement between the parties, suspending all oral or written prior agreements and all other communications between the parties relating to the subject matter of this Warranty, including statements made by salesperson. No employee of ProSoft or any other party is authorized to make any warranty in addition to those made in this Warranty. The Customer is warned, therefore, to check this Warranty carefully to see that it correctly reflects those terms that are important to the Customer.

6.3.9 Allocation of Risks

This Warranty allocates the risk of product failure between ProSoft and the Customer. This allocation is recognized by both parties and is reflected in the price of the goods. The Customer acknowledges that it has read this Warranty, understands it, and is bound by its Terms.

6.3.10 Controlling Law and Severability

This Warranty shall be governed by and construed in accordance with the laws of the United States and the domestic laws of the State of California, without reference to its conflicts of law provisions. If for any reason a court of competent jurisdiction finds any provisions of this Warranty, or a portion thereof, to be unenforceable, that provision shall be enforced to the maximum extent permissible and the remainder of this Warranty shall remain in full force and effect. Any cause of action with respect to the Product or Services must be instituted in a court of competent jurisdiction in the State of California.

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